AMERICAN PLUMBING

Alfred Revill

AMERICAN PLUMBING

A COMPLETE COMPENDIUM OF PRACTICAL
PLUMBING, FROM SOLDER MAKING
TO HIGH-CLASS OPEN WORK

BY

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AMERICAN PLUMBING.

PART I.

THE ART OF PLUMBING IN THE ABSTRACT.

PLUMBING as a trade has kept pace tolerably well with modern progress, although there is still much to be done in the line of improvement. No trade connected with house-building is of such importance as plumbing, the health of the tenants depending, we may say, almost entirely upon the sanitary appliances and their connections, which are used to convey all waste and foul matter into the sewer, and *above all to prevent the entrance of noxious gases.*

It is the latter consideration which has caused an almost complete revolution of methods in plumbing. It was always, and is now, where the sewers are good, a comparatively easy matter to dispose of any refuse which will run through a pipe. A sufficient fall to facilitate the rapid running of water is all that is required for that purpose. But when we are presented with the

problem of letting refuse out, without permitting the gases, which inevitably arise, from coming in, we have before us the problem which it has become the plumber's province to solve, and which has produced the mysterious and complicated looking system of pipes which are to be found in a modern dwelling.

To the world at large, plumbing means little more than a knowledge of joining two pieces of lead pipe together, mainly for the purpose of enabling the presentation of a bill, the size of which, in its footing, is invariably said to be out of all proportion to the amount of work done.

That this idea was partly true in connection with the old-time plumber is no doubt the case. It does not hold good now, however, and certainly not in a large city, where the ordinances are so framed that a plumber must know something beyond the ability to make a joint, or to put up a sink and connect it.

A tremendous change has come over plumbers' work within the past few years,—a change which has resulted in better health, a lower death-rate, and which in time, as more improvements are adopted, may lead to a practical extinction of all those dreadful diseases, traceable in every case to defective plumbing, which allowed sewer gas to enter the dwelling.

Go into a first-class modern residence, take a peep at its well-fitted bath-room with its highly polished exposed work and often very complicated sanitary appliances;

bring in the old-time plumber and he would simply stand aghast at such an exhibition of magnificence, and no matter how skillful he may have been at the bench, he would find himself utterly unable to do a tithe of the work done by his modern brother in fitting up such a job. Sanscrit would be as simple to the old-timer as the connections and adjustments of modern appliances and fixtures. He would practically be compelled to learn his trade all over again, as the knowledge he previously gained would be but a very slight factor in plumbing a modern house.

A visit to the New York Trade School would further serve to enlighten us as to what is expected of the plumber nowadays. The specimens of work done and shown there, demonstrate that not only is the modern plumber compelled to be as skillful as his predecessors ever were in the details of his craft, but he has to become familiar with applications of these details that his grandfathers never dreamed of, and would not have understood if they had.

The survival of the fittest holds good in plumbing as in everything else, and the young man desirous of becoming a plumber, who leaves the study and comprehension of sanitary devices to the manufacturer and the architect, will never be able to compete with the plumber who prepares himself for his profession by an intelligent course of study, that will enable him to thoroughly grasp the *raison d'etre* of all the appliances he employs

The following pages, therefore, while thoroughly practical as to details, are tuned to the modern pitch and designed to convey the truth, that sanitary science and plumbing are synonymous.

We are indebted to the *Plumbers' Trade Journal* for many illustrations in this work.

PART II.

LEAD AND ITS USES IN PLUMBING.

ALTHOUGH blacksmithing is always supposed to be the oldest trade, making iron the first metal used, it is more than probable that lead was the first metal discovered. It was called Saturn by the ancients, and it was certainly used by the Israelites, as they made leaden statues of the leaden spoils taken from the Midianites. According to geology lead is found in the primary and transition rocks (except trap-rock), also in porphyry, syenite, and the lowest sandstone. It is found occasionally with coal.

Galena, or sulphide of lead, is the correct name for lead ore; it is found all over the globe, and is by the application of heat resolved into pure lead. The following is a list of the different kinds of lead known to chemists:

SULPHURETS.

1. Galena.
2. Blue lead ore.
3. Black lead ore.

OXIDES.

1. Earthy ore of lead.
2. Arseniated Protoxide.
3. " Peroxide.

SALTS.

1. Carbonate.
2. Muriacarbonate.
3. Sulphate.
4. Phosphate.
5. Molybdate.
6. Arseniate.
7. Arsenio-phosphate.
8. Chromate.

The first is by far the most valuable, and from it is obtained nearly all the lead of commerce. Large quantities are produced in the United States. Pure galena contains 86.55 parts of lead and 13.45 of sulphur. It is frequently impregnated with other metals, such as silver, iron pyrites, antimony, gold, etc. Silver is the most frequent, and is extracted in quantities varying from one to eight per cent., though the latter is rarely the case; two per cent. is a good paying quantity when lead is worked for silver. There are many ways of obtaining the silver, etc., from lead, but as the plumber has to do with lead alone, we will confine ourselves to its uses in his trade.

Except for bullets, the ancients used lead in much the same way as we do now—that is to say, they made lead pipes and used them for water; they also made sheet lead for roofs, and put it on just as we do.

Chemically considered, the peculiarities of lead are as follows: Its symbol is Pb., from the Latin word *Plumbum*, which means lead, and from which is derived the word plumber; its EQUIVALENT is 103.56.

COMBINING WEIGHT, 207.

SPECIFIC GRAVITY, about 11.45 (it varies according to circumstances).

COLOR, bluish gray. Its density is reduced by hammering, for the reason that it becomes heated, and opens its pores.

The FUSING POINT varies from 594° to 635° Fahrenheit, but is generally about 612°. If heated to fusion in the open air it becomes covered with a thin oxide of iridescent colors. A very strong heat will cause it to boil and evaporate.

MALLEABILITY.—It is the seventh among metals.

Its ELASTICITY is very small; it has no musical sound when struck, as other metals have. It contracts when cooled, can be permanently enlarged by heating, is the worst conductor of the seven common metals, and for the last reason is very useful for hot-water pipes.

Its TENACITY is very low, about $\frac{1}{20}$ that of iron.

Lead when exposed to the action of damp air turns to a dark color (*protoxide*, or *Pb. O.*); if the exposure be prolonged, it becomes white lead, which is caused by the carbonic acid in the atmosphere; it is therefore necessary to make the covers of lead cisterns of some other material. Dry air does not affect lead.

Lead traps and pipes must be perfectly ventilated in order to prevent corrosion. As decay is certain to take place through chemical action, the most perfect ventilation must be maintained. A well-ventilated trap will

last twenty times as long as a trap which is not ventilated. It is the confined carbonic acid gas which corrodes the lead, and soon causes the surface of a trap above the water-line to become a mass of oxycarbonate of lead, which is deposited in white scales.

Many kinds of water corrode lead very quickly and form a deadly poison; where this is the case it is well to lime white leaden cisterns and leaden pipes which are to contain water. This will form a crust on the lead, and protect it from the action of corrodable waters.

Lead is readily dissolved in nitric acid.

A pig of lead is three feet long, and varies in weight in different countries. A *fotder*, or fodder of lead, is about a ton weight, but neither term is definite.

A few words as to lead poisoning may not be out of place. It may be introduced into the system in the form of fumes, with the food, or by drinking water which has passed through leaden pipes; it shows itself by the blackness of the teeth, violent pains in the bowels, limbs, and muscles, and after several attacks causes paralysis and death.

LEAD PIPE.

Lead pipe was formerly made in 12-foot lengths, but now, by virtue of improved machinery, is made of any length and of any gauge. Like all other materials, it varies in quality; a hard, tenacious metal, weight for weight, will stand more pressure than a soft one. There

is no reliable theory whereby the actual strength of lead pipe may be ascertained. The following table is worked out from actual experience.

The length for a coil of lead pipe from ¼ of an inch to 1 inch in diameter, is 60 feet ; from 1¼ to 2 inches, the bundle is 36 feet long. On account of the weight larger sizes are made in lengths only, as follows :

15 FEET LENGTHS.

Diameter of bore in inches.	Weight of length of 15 feet.	Safe for a column of water, in feet.
¼-inch.	20 lbs.	600 feet.
⅜ "	15 "	50 "
" "	20 "	250 "
" "	25 "	500 "
½ "	14 "	50 "
" "	18 "	100 "
" "	20 "	200 "
" "	22 "	300 "
" "	25 "	400 "
" "	28 "	500 "
" "	30 "	600 "
⅝ "	18 "	100 "
" "	22 "	200 "
" "	30 "	500 "
¾ "	22 "	40 "
" "	24 "	80 "
" "	26 "	100 "
" "	28 "	150 "
" "	32 "	250 "
" "	36 "	350 "
" "	42 "	500 "
" "	45 "	600 "
1 "	30 "	30 "
" "	36 "	60 "
" "	42 "	100 "
" "	48 "	200 "
" "	56 "	305 "
" "	60 "	400 "
" "	64 "	450 "

12 Feet Lengths.

Diameter of bore in inches.	Weight of length of 12 feet.	Safe for a column of water, in feet.
1¼-inch.	36 lbs.	25 feet.
" "	42 "	60 "
" "	48 "	120 "
" "	52 "	250 "
" "	60 "	500 "
1½ "	36 "	20 "
" "	48 "	50 "
" "	5 "	100 "
" "	72 "	250 "
" "	84 "	400 "
" "	96 "	550 "
1¾ "	72 "	100 "
" "	84 "	200 "
" "	96 "	300 "
2 "	36 "	15 "
" "	56 "	50 "
" "	64 "	80 "
" "	72 "	100 "
" "	84 "	200 "
" "	96 "	300 "
" "	112 "	400 "
" "	120 "	500 "

Lengths of 10 feet weigh as follows:

2½ inch bore weighs 36, 70, 84, 96, 112, 130 lbs.
3 " " " 42, 60, 80, 100, 112, 120, 130, 140 lbs.
3½ " " " 56, 90, 112, 120, 130, 150, 160, 180 lbs.
4 " " " 56, 70, 80, 112, 140, 150, 170, 180, 200 lbs.
4½ " " " 60, 84, 112, 140, 170, 200, 220 lbs.
5 " " " 170, 200, 234, 254, 280 lbs.
6 " " " 300 lbs.

The two last are used for pumps only, also the heavier weights of the smaller diameters.

SHEET LEAD.

Lead which is to be milled is first melted and cast in an iron pan about 7 feet by 5 or 6 feet, and from 5 to 6 inches deep, according to the material required when finished. It is then (when cold) passed as many times between the rollers of a lead-rolling mill as may be required to reduce it to the correct thickness. After finishing, the sheets are rolled up, weighed and stamped, the number, length, and thickness (or gauge) in pounds per square foot. Sheet lead, however, never runs exact as to weight; it is generally thick at the ends.

Following is the thickness of sheet lead to square foot, and while the table is not precise, it is near enough for all practical purposes.

A cubic foot of lead weighing 709 lbs. will give:

A square foot	1 inch	thick	....	59	lbs.
"	" $\frac{2}{15}$	"	....	8	"
"	" $\frac{1}{8}$	"	....	7½	"
"	" $\frac{1}{10}$	"	....	6	"
"	" $\frac{1}{12}$	"	....	5	"
"	" $\frac{1}{15}$	"	....	4	"
"	" $\frac{1}{20}$	"	....	3	"

Lead ⅛ inch thick is what is known to plumbers as 7 lb. lead.

Sheet lead is rolled sometimes into what is known as laminated lead and lead-foil. It can always be distinguished from tin-foil, as the latter is far more crisp.

PART III.

SOLDER—METALS AND ALLOYS—FUSING POINTS—SOLDER-MAKING.

SOLDER is an alloy which is used to join pieces of metal together. It is available for that purpose because it melts at a comparatively low temperature. After lead it is the most important substance with which the plumber has to do.

Although it may be purchased ready prepared for every kind of use, it is well for the plumber, especially in a country shop, to know how to make it. First, however, we will give a table showing the fusing point of all the common metals.

FUSING POINT OF METALS.

Antimony..................	Melts	810	deg. Fahr.
Bismuth	"	500	"
Copper....................	"	2,000	"
Iron	"	2,912	"
Lead	"	612	"
Silver....................	"	1,832	"
Tin.......................	"	428	"
Zinc	"	773	"
Water	Boils	212	"
Mercury	"	662	"

It will readily be seen that in order to solder any metal, we must use a solder the melting point of which is lower than that of the metal to be soldered. The following table, compiled with the greatest care, can be depended upon:

MELTING POINTS OF DIFFERENT SOLDER ALLOYS.

NAME OF SOLDER.	LEAD.	TIN.	BISMUTH.	MERCURY.	CADMIUM.	MELT. POINT
						Fahr.
	20	1	..	..	..	550
	10	1	..	..	..	530
	5	1	..	..	..	510
Coarse	3	1	..	..	..	480
Plumbers'	2	1	..	..	..	440
Fine	1	1	..	..	..	370
Tin pipe	1	1½	..	..	..	330
	1	2	..	..	..	340
	1	3	..	.	..	350
	1	4	..	..	..	360
	1	5	..	..	..	375
	1	6	..	..	..	380
	4	4	1	..	..	330
Pewterers'...........	3	3	1	..	..	315
	2	2	1	..	..	290
	1	1	1	..	..	250
	2	1	2	..	..	234
	5	3	8	..	..	212
	1	1	2	..	..	201
	3	5	3	..	..	200
	3	2	5	..	..	199
	1	0	4	⅓	..	185
	6	0	7	..	1	180
	3	2	5	1	..	167
	4	2	⅞	..	½	150
	3	5	3	3	..	122

Expanding metal is made of:

Lead............................ 9 parts.
Antimony...................... 2 "
Bismuth .... 1 part.

This expands on cooling.

It is the antimony which expands, but antimony alone would be of no use.

To mix lead and zinc, use arsenic.

To harden lead, use tin or zinc.

To increase the tenacity of lead, use 12 parts lead and 1 part zinc.

To separate lead from zinc, heat to a white heat. The zinc will volatilize and the lead remain.

SOLDER-MAKING.

To make plumber's solder, take one cwt. of lead (scraps and cuttings), melt it, and remove all the dirt and dross. Then take 56 lbs. of tin and melt it also; throw in ½ lb. of black resin, heat the whole to about 600 degrees, and stir it well. You can tell when it is hot enough by inserting a piece of newspaper, which should blaze quickly. Pour the mixture into moulds, which can be purchased of any plumbers' supply house.

To make fine solder, mix half lead and half tin. It melts at 370° Fahr.

Blow-pipe solder is made of 1 part lead and 1½ parts tin. It melts at 330° Fahr. Blow-pipe solder is always made into small strips or rods. Get an old iron ladle,

and bore a hole in it ⅛ of an inch in diameter, and let the hot solder run through it on to a sloping slab.

Always be careful to have no zinc anywhere around your implements when making solder.

Bad solder is that which has been burnt or contains zinc. Some solder will work well for about six or ten heats, and then spoil, becoming coarse, like sawdust ; by adding more tin it can be made workable.

PART IV.

PLUMBERS' TOOLS.

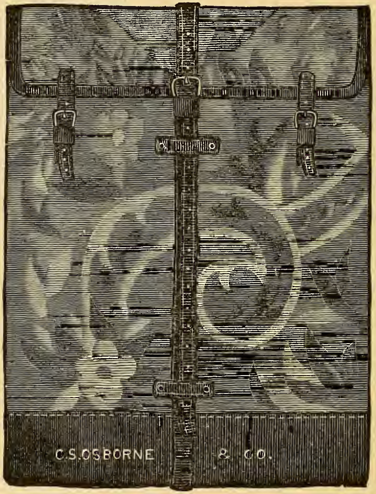


Fig. 1.

THE PLUMBER'S BAG.

These bags are used for carrying tools to work, and are best made of good Brussels carpet. An ingenious plumber could easily make one for himself, but they can be bought all ready for about $3.

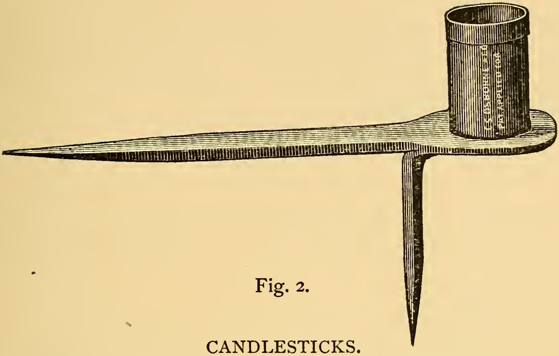


Fig. 2.

CANDLESTICKS.

The most useful form is shown in the drawing. It can be made to hold itself in almost any position by means of the spurs.

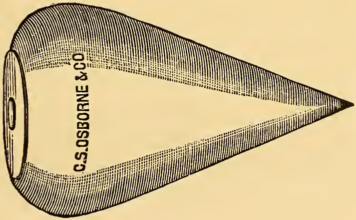


Fig. 3.

TURN-PIN.

Without the turn-pin, a plumber who has a joint to make would be helpless. They are made of hickory or boxwood, and should always be taken good care of.

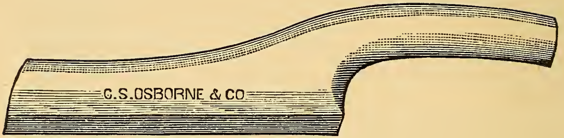


Fig. 4.

DRESSERS.

The dresser is for use in beating lead to render its surface even.

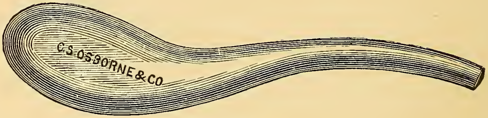


Fig. 5.

BOSSING-STICKS

are used to beat up bends, etc., and for shaping lead generally.

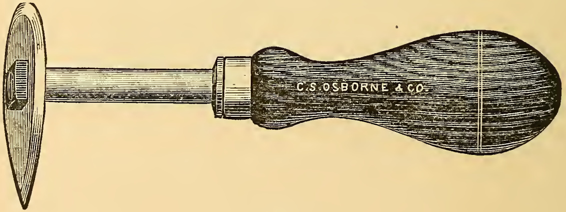


Fig. 6.

SHAVE-HOOKS.

Shave-hooks are of all shapes, with square holes in the centre for the purpose of fastening them to the han-

dle, which is made with a nut for the purpose. There are other shave-hooks of various shapes but smaller, and come fastened permanently into a handle.

SOLDERING-IRONS.

Soldering-irons, technically called "irons," are of various shapes, according to the work to be done. Following are cuts of the three important irons, with their names.

Fig. 7.

ROUND IRON.

This is an iron to be found in every plumber's shop. Its shape is such that places which could not be reached with any other iron are comparatively easy to be got at. It retains the heat more or less according to size.

Fig. 8.

COPPER-POINTED BOLT.

This bolt, and another known by the same name, but which is shaped like a chisel, are shown without the handles. Roofers use the same tool, but much blunter at the point.

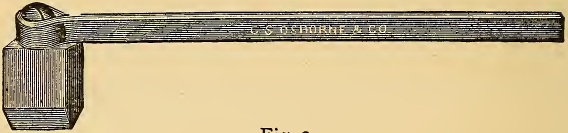


Fig. 9.

COPPER HATCHET BOLT.

Is for the same purposes as the copper bolt, but its shape enables it to be used where the other could not.

Fig. 10.

LADLES.

The ladle is of various sizes, from 2½ inches across to 8 inches or larger. It is used to dip melted lead or solder from the melting-pot. Do not use it to melt solder in; it is not meant for that purpose, and should always be kept clean.

Fig. 11.

CALKING CHISELS.

Calking chisels are used for driving the oakum or lead into spigot and socket joints, which are used for joining soil-pipe, and will be explained later on. A

yarning iron is a similar tool, but much thinner and longer from the offset to the point.

Picking chisels are used to take the lead and oakum out of a joint which is to be remade.

Fig. 12.

LOOKING-GLASS.

A looking-glass must be carried in every plumber's kit. It is used for the purpose of seeing the back or under side of joints, etc., which cannot be reached by the eye direct.

Fig. 13.

BENDING PINS.

Bending pins and kinking irons are made of steel of various shapes, straight, bent at one end or bent at both ends.

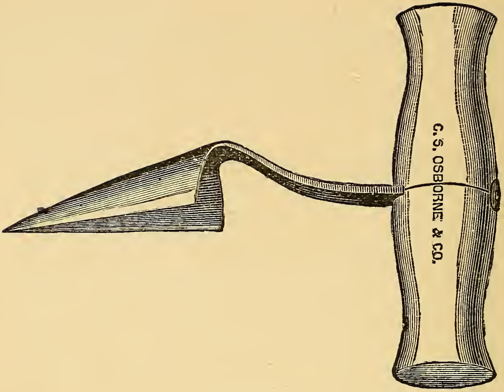


Fig. 14.

TAP BORER.

The tap borer is a very useful tool for enlarging and tapering a hole for the insertion of a tap, faucet, spigot, or branch joint.

Fig. 15.

COMPASSES AND CALIPER.

Compasses need no description, their use is obvious. Calipers are used to measure diameters, and are made of all sorts of shapes and sizes for inside and outside measurement.

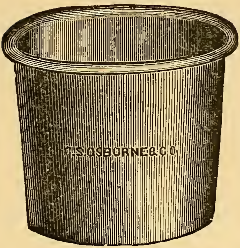


Fig. 16.

SOIL CUPS.

Almost any receptacle does for the purpose of holding soil, but they are made of seamless metal, and sold by the supply houses. A good plumber will certainly use no makeshifts.

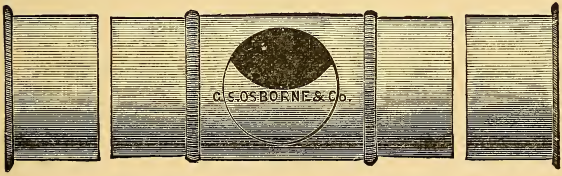


Fig. 17.

GREASE BOX.

The drawing shows a grease box made in three divisions. It will hold resin, paste, and grease.

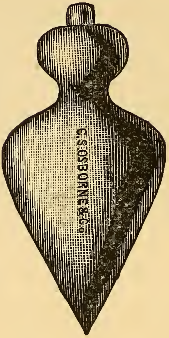


Fig. 18.

PLUMB BOB.

This instrument is indispensable for the correct running of pipes, especially those that are perpendicular.

Fig. 19.

POT-HOOKS.

Pot-hooks are simply used to lift the pot from the fire, and are very necessary. Don't get slovenly and use the hammer.

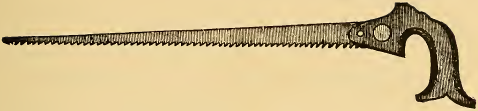


Fig. 20.

COMPASS SAW.

The compass saw is used to cut circular holes in wood-work for the passage of pipes.

Fig. 21.

DOUBLE-EDGED SAW.

The double-edged saw is very useful, as it combines two tools in one,—a saw for metal and a saw for wood.

HACK SAW.

No shop can get along without this tool, which is used on every kind of metal (don't try it on hardened steel). If you have to cut a brass tube, or any tube, the metal of which is light, use an old blade; if the teeth are all gone, so much the better. A new saw will lose a majority of its teeth in the first application to a thin metal tube.

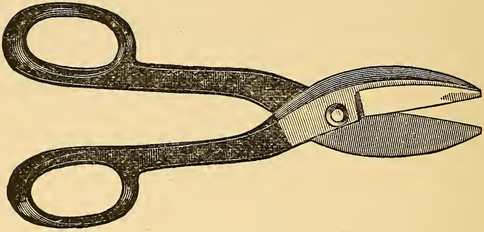


Fig. 22.

SNIPS.

Snips, so-called, are shears with a short blade and long handle, and are used for cutting sheet metal. They are also made with curved blades for circles.

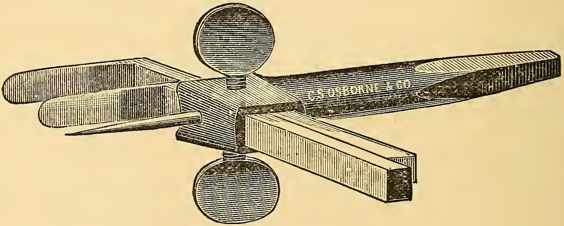


Fig. 23.

WASHER-CUTTER.

Every plumber should possess a washer-cutter. It is used in the brace, and by setting the two knives will cut any size washer from leather.

THE BRACE.

A ratchet-brace is the best. They are now sold so cheap that it is scarcely worth while to bother yourself with an inferior brace. By means of the ratchet-brace you can bore a hole in any corner, which is impossible with the old style brace. What is called an angular borer is also sold. It is used with the brace, and will bore a hole " around the corner."

FURNACES.

A charcoal furnace is generally used on the job. There are gas furnaces, etc., made for use in the shops. There are also blast furnaces, which use naphtha, and are useful when a quick heat is wanted.

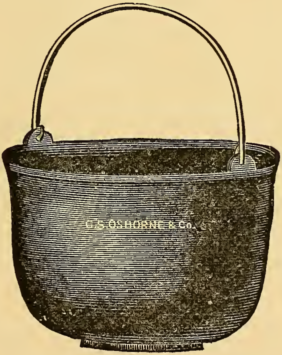


Fig. 24.

SOLDER-POT.

Solder-pots are made usually of cast-iron of various sizes.

BLAST TORCH.

This tool is used for making the joints known as blown and burnt joints.

Fig. 25.

ALCOHOL TORCH.

The alcohol torch is for use with the blow-pipe, and is used for blown joints.

Fig. 26.

BLOW-PIPES.

The proper use of the blow-pipe requires considerable practice. Workmen accustomed to its use can be seen causing a constant stream of air to pass through it, and if asked how they do it, always evince a disinclination to tell. The secret is simple, and by following the directions given, you can, after a while, learn the knack. When blowing, do so with two objects: first, to cause the air to go through the pipe; and, here lies the secret, second, to fill the mouth with air at the same time. The object of this is: You must breathe, and the breath must be drawn through the nostrils. Now, while you are drawing your breath your mouth is full of air; by using the cheeks as bellows you can make the air in your mouth keep up the stream while you are taking in a fresh supply through the nose. The author was a long while finding out how to do this, but no one told him the method.

MONKEY-WRENCHES,

also known as screw-wrenches. There are numberless styles, each one of which is claimed by the manufacturer to be better than any other. They are all good when properly made.

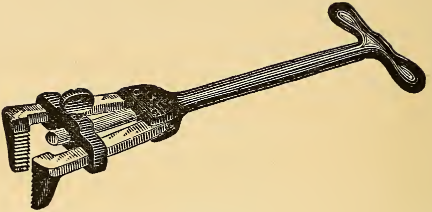


Fig. 27.

BASIN-WRENCHES.

Buzzell basin-wrenches are the best, and have entirely superseded the old style.

PIPE-WRENCHES.

Of all the pipe-wrenches in existence the Stillson seems to have been awarded the palm. Some of the plumbers' Unions, when making a list of tools which a journeyman should possess, even specify the "Stillson" wrench. There are others, of course, notably the "Briggs," the "Barnes," the "Rouse," and the "Armstrong." The principle is the same in all, and the object is to make the wrench grip the tighter the harder you pull. Monkey-wrenches are of no use whatever on pipes or anything that is round.

Pipe tongs are used for the same purpose as pipe-wrenches.

PLIERS.

Four kinds of pliers are shown, as follows:

Fig. 28.

END-CUTTING PLIERS.

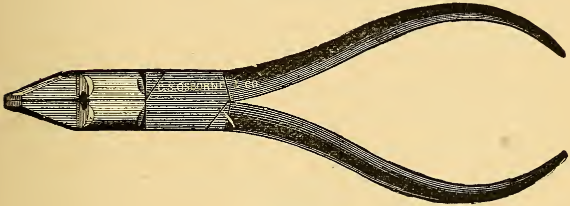


Fig. 29.

SIDE-CUTTING PLIERS.

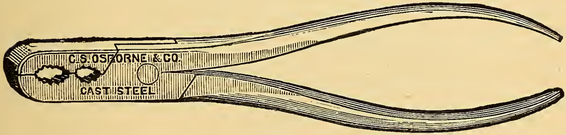


Fig. 30.

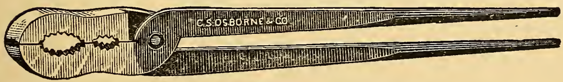


Fig. 31.

GAS PLIERS.

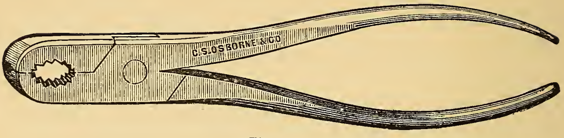


Fig. 32.

BURNER PLIERS.

PIPE-CUTTERS.

Pipe-cutters are made with either wheels or knives to do the cutting. With them gas-pipe can be very easily cut.

STOCKS AND DIES.

Stocks and dies are used for cutting screw-threads on pipes. Machines are also made, costing as high as $100, which cut and thread pipes by turning a crank.

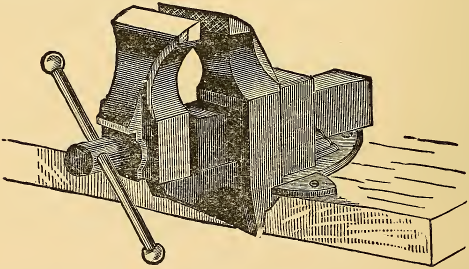


Fig. 33.

BENCH VISE.

Bench vises are of many styles. The one shown in the illustration is perfectly reliable. A pipe-vise is on the

same principle, but is made with jaws especially shaped to hold pipes of all sizes.

TAPS.

Taps are tools used for threading the inside of pipes, nuts, etc., etc. A tap-wrench is to hold the tap, and should never be used for any other purpose.

CROW.

The crow is used in drilling and tapping street-mains, etc. It grips around the pipe, and is provided with a screw for the purpose of forcing the drill into the iron pipe as it cuts.

RUBBER FORCE-CUP.

This is very useful, especially for sinks. In using it, it is placed over the sink outlet and by forcing it down, is supposed to compel the water and stoppage in the pipe to move. A sink stoppage, ninety-nine times out of one hundred, is caused by accumulations of grease and dirt in the trap. Take out the trap screw and clear the trap first; if that does not work, then try the force-cup. A good dose of lye will clear grease away.

RATCHET DRILLS.

Ratchet drills are for use in connection with the crow for boring pipe.

SOLDER MOULDS.

Fig. 34.

This mould is used to cast the solder into convenient shape for use with the irons or torch.

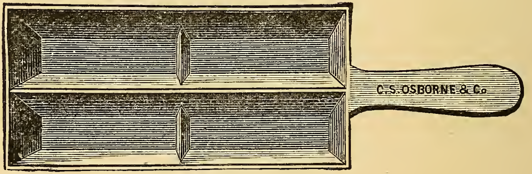


Fig. 35.

This mould is for solder intended for use with the ladle.

The above drawings of solder moulds, Fig. 34 and Fig. 35, need no further explanation, as they are simply for the purpose stated.

TACK MOULDS.

Plumbers' tacks are usually about the first thing an apprentice is set to work to make. They are either single or double, besides what is known as a "side tack." Tacks now come ready-made of all kinds, and are in many cases much to be desired, especially where they dispense with the use of solder.

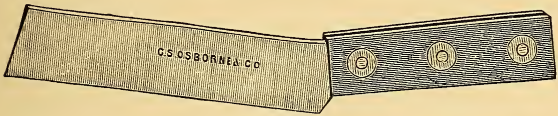


Fig. 36.

CHIPPING KNIFE.

Fig. 37.

CAPE CHISEL.

Fig. 38.

COLD CHISEL.

The cold chisel is used to chip iron pipes, or to cut them in two. It is a most necessary tool.

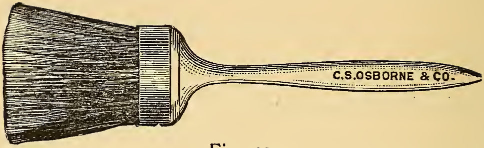


Fig. 39.

DUSTER.

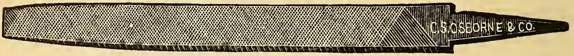


Fig. 40.

FILES.

Files and rasps are of all sorts and sizes. Those files which are of a coarse cut are mostly used by the plumber on lead. The finer files are for brass and iron.

Fig. 41.

FIRMER CHISEL.

This chisel is made in one piece of metal without a wooden handle, especially for plumbers' use.

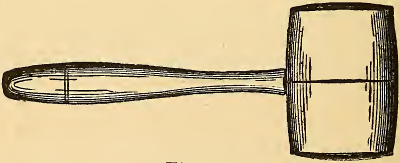


Fig. 42.

MALLET.

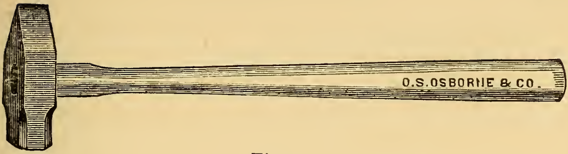


Fig. 43.

PLUMBERS' HAMMER.

There are many kinds of hammers, but the shape shown in Fig. 43 is the most useful for a plumber—the face and peen being specially adapted to his work.

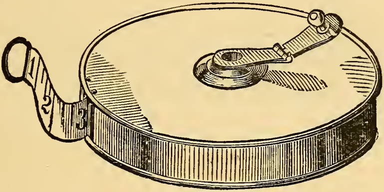


Fig. 44.

MEASURING-TAPE.

For measuring lengths of lead pipe the measuring-tape is much to be preferred to a two-foot rule, which requires a mark at every two feet. A small fraction wrong in each will amount to considerable in a long length.

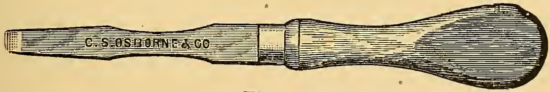


Fig. 45.

SCREW-DRIVER.

Fig. 46.

WOOD CHISEL.

These are the same chisels as are used by carpenters, and are made for use with a wooden handle.

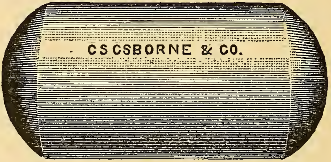


Fig. 47.

DRIFT-PLUGS.

Drift-plugs are round pieces of wood, varying in diameter according to the size of the pipe in which they are to be used. They are for the purpose of straightening out kinks, and are driven through the pipe by means of a rod or anything of slightly smaller diameter.

SAND-PLUGS.

Sand-plugs are used to stop up the ends of a pipe when sand is used for bending.

Besides the tools already illustrated and described there are many others; some of them indispensable,

and the remainder sure to be wanted at some time or other in plumbing, viz.:

Augers.	Pocket-knife.
Bits.	Rasps.
Brad-awls.	Scratch-awl.
Chalk-line.	Soil-brushes.
Clark's expansion-bit.	Two-foot rule.
Gimlets.	Two-foot steel square.
Level.	Trowel.

We have now given a pretty complete list of the tools which a plumber must know how to use.

All the tools mentioned can be obtained from C. S. Osborne & Co., Newark, N. J.

PART V.

MAKING JOINTS AND BENDS.

THERE are several kinds of joints used by plumbers, according to circumstances; the names are as follows:

Overcast joint, also known as striped joint.
Flange joint, or taft joint.
Underhanded joint.
Upright joint.
Copper-bit joint.
Blown joint and burnt joint.
Astragal joint.
Lead joint.

Wiped joints are supposed to be the perfection of joint-making. There is no good reason, however, for this supposition, as under many circumstances the copper-bit or blown joint is equally efficacious.

The tools used in making joints are the turn-pin, saw, rasp, shave-hook, fixing chisels, clamps, and the cloth or cloths.

The saw, which should be from 15 to 18 inches long, is used to cut the leaden pipe square across; then take your knife and cut all the ragged or jagged bits of lead from the inside of the pipe, being careful that none of

the shavings stay inside; then select the most suitable turn-pin, and, after wetting it with water, place it in the end of the pipe, holding the top of the turn-pin between the thumb and forefinger while the pipe rests in the palm of the hand, and is held there by the other three fingers. Now strike the turn-pin lightly and squarely in the centre; in case the opening becomes uneven, more to one side than the other, you must strike on the opposite side, which will fetch it even. A little practice will soon enable you to make a good job. Keep the turn-pin always wet. It is more than likely the pipe will show signs of splitting. If it does, beat the edge with the mallet, which will thicken the metal; by adjusting the thickening process to the effect produced by the turn-pin, a pipe may be opened to almost any size.

The next tool required is the shave-hook, or the pocket-knife, which often answers as well. With it shave around inside as much surface as is required for soldering, then rub a tallow candle over the cleaned portion, and this part of the joint is ready. It is known as the female end.

The other end, which is called the male part, is now to be prepared. First, rasp the end off perfectly square, then rasp the pipe to a taper, which must be the same as the taper of turn-pin or it cannot be expected to fit. It must fit so that no solder can run into the pipe. The ends must now be shaved up to the point the solder is to reach. A mark should first be made around the pipe, and the shaving be done from the mark toward the end.

The operation is simply to clean the leaden pipe so that the solder will take properly.

Now there are hundreds of places where you must find some method to fix your work while soldering it. Suppose the joint to be an upright one, and to be made against a wall; drive a couple of fixing-chisels into the wall, one above and one below the joint, and at a sufficient distance apart. Tie the male end with the cord to the upper chisel and the female end to the lower chisel—never reverse this order of proceeding or the solder will be apt to run out of the joint. See that the whole is now firm and not liable to shake. If it does shake, use more chisels to steady it.

There are clamps made on purpose for holding upright joints, and every plumber's shop should have one, as they are handy for fixing all kinds of work, such as bosses, union linings, cocks, valves, pipes, etc., while the joint is being made. Holders are also made, or can be improvised, for any sort of joint.

The joint being now prepared, and to be finished as a *copper-bolt joint*, you will take your copper hatchet bolt, the face of which must be well tinned about half of an inch up each side of the V-edge, and it must be perfectly clean. Put some pounded black resin around the joint, and then melt a little solder all around. Having melted sufficient solder to fill in all round, run the nose of the soldering-iron into the solder and tin the lead well; float the solder (with the iron well heated) all around the

joint. If properly done, the joint will be as smooth as the pipe itself.

A blown joint is prepared in the same manner, but instead of an iron the blow-pipe is used.

If you intend to make a blown joint you must use blow-pipe solder, which should not be more than an eighth of an inch thick, or it will require too much heat. (There are all sorts of lamps made for plumbers' use in soldering; any one of them will do the work.)

Begin by putting a little powdered resin around the joint; now blow the flame on the joint, producing a heat sufficient to melt the solder but not the lead; keep on adding a little more resin and solder, and blow until you have just heat enough to cause the solder to run and unite with the lead, and the joint is made. The point to be observed is, to get just the right heat.

PREPARATION OF WIPED JOINTS.

Wiped joints are not by any means so easy to make as copper-bolt joints, and require considerable practice. In the first place, you will prepare the ends of the pipe just as you did for the copper-bolt or blown joint, except that the shaving must be longer, and the female end will not require to be opened quite so wide, or it would make the joint too bulky. For a wiped joint the ends must be free from grease or oil; this is done by rubbing with powdered chalk or whitening, afterward rubbed off with a clean rag. Next comes the soiling,

which, though of importance to the novice, can be dispensed with by the practiced hand.

Soil, or tarnish, is prepared as follows: Take a package of lampblack, empty it into the metal pot, and heat it until red-hot, then let it cool; now mix with it about half a teacupful of finely-powdered chalk; use beer to mix it, and grind the whole up well, making it about as stiff as good mortar; add a good tablespoonful of melted glue, and stir well over the fire. For use, it should be about the consistency of cream, and is applied with a paint-brush, technically known as a sash tool. When putting it on don't daub the work all over. Soil the joints from 3 to 5 inches past the solder line. Upright joints require the most soiling. The soiling is to prevent the solder from sticking on the wrong place. A large joint should be practiced upon first, as it is the easiest to make, the larger quantity of solder retaining the heat longer. Having all prepared, fix the joints together as in the copper-bolt joint.

We have already spoken of shaving for joints, but as it is well to have some definite rules to go by, we will give the length of shaving for different sizes of pipe. For wiped joints the pipe which is to go inside should be rasped off ½ inch in length. This is called long-rasping off, and is the best.

½-inch pipe joint the shaving should be 2½ inches long.
¾ " " " " 2¾ "
1 " " " " 3 "

1¼-inch	pipe joint	the shaving	should	be	3¼	inches long.
1½	"	"	"	"	3½	"
2	"	"	"	"	4	"
3	"	"	"	"	3½ to 4	"
4	"	"	"	"	3½ to 4	"
5	"	"	and all sizes over,		4	"

The cloth is a very important tool to the plumber, and he should always have a good clean stock of them on hand. It is made as follows: Take a piece of new ticking or moleskin woolen cloth of moderate thickness and 12 by 9 inches in size, fold it in three folds, which will make it 4 by 9 inches; then fold it once again, making it of six thicknesses, and it will be 4 by 4½ inches in size, which is just right for jointing ½ or ¾-inch pipe. Sew up the edges to keep them from opening, melt a little tallow and pour it on one side of the cloth, this is to keep the solder from sticking; always use this side of the cloth, and now and then put on a little tallow. Larger cloths are required for larger sizes of pipes, up to a cloth of ten thicknesses, measuring 9½ by 10 inches for use on 5 or 6-inch pipe. Still larger joints are worked by using a glove-cloth, followed by a smaller or ordinary cloth.

The splash-stick is made of wood, about 6 inches long and 1¼ inches wide. Iron is sometimes used, and is the best when the solder is very hot, as it will then burn the wooden one.

If the joint to be wiped is an upright, you will need a collar to catch the solder. Cut out a piece of sheet-lead

with a hole in the centre the same diameter as the pipe; cut it from the outside edge to the edge of the hole, and by opening it sideways slip it into the pipe, after first tying a piece of string around the pipe at the proper place, which will serve to keep the collar from slipping down. Pack it with paper if it does not fit just right, brush it with soil, and it is ready.

Before you begin to wipe the joint (an upright), which is now ready, you must see that there is no draught through the pipes; stop the ends. The helper will bring you the metal; take an old piece of felt with which to hold the ladle, fill the ladle with solder, and go to work, splashing it on the joint with the splash-stick. Take care not to burn the pipe with the solder, which can be done by splashing in too much in one place. Get up the heat by putting on as much solder as you want, and as near to the shape as possible. Keep it alive by working it up with the splash-stick. If it drops down, push it up again with the stick, adding more solder to keep it hot. Take another ladle of solder and splash it around and up on the soiling, patting it into proper shape with the splash-stick. It should now be just hot enough; take the cloth, well heated on the face side, in the left hand, and with a quick, wide sweep wipe clear around the top and back part of the left-hand side of the joint, then the bottom, next the centre; change hands and do the other side, and your joint is done.

All this, which has taken a great deal of description,

will take about one and a half minutes altogether ; the wiping operation will not take more than 20 seconds.

TO WIPE AN UNDERHANDED JOINT.

For making underhanded joints, first place a small piece of paper under the joint to catch the surplus solder and begin soldering as follows : Take the felt in your right hand and with it hold the ladle three parts full of solder. To see that it is not too hot, hold the

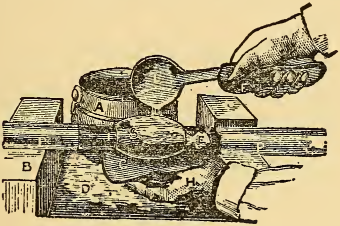


Fig. 48.*

back of your hand within two inches or so of the solder. If it quickly burns your hand it is too hot ; if you can only just hold your hand this distance away without pain, use it ; but if you cannot feel the heat, it is too cold. This is soon known by a little practice.

Another test is to take a little piece of newspaper and immerse it below the metal ; if it blazes instantly it is too hot ; if it browns quickly without burning, use it. When you begin to pour your solder upon the joint do

* From the *Plumber's Trade Journal.*

it very lightly, and not too much on at a time in one place; but keep the ladle moving backward and forward, pouring from E to J (Fig. 48), first on one side of the joint to the other and from end to end; also an inch or two up the soiling, as shown at E, on purpose to make the pipe nice and hot, and to the same heat as the solder.

The further in reason the heat is run or taken along the pipe, the better chance you will have of making

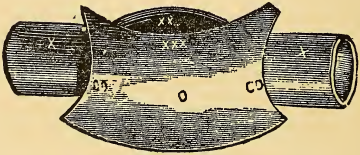


Fig. 49.*

your joint. Keep pouring away, and with your left hand hold the cloth, C, to catch the solder, and so cause the same to tin the bottom of the joint (especially looking after this point in large joints), and to prevent the solder from dropping down.

The cloth is shown in Fig. 49 as it should be held when tinning the bottom of the joint; it is somewhat bulged or bagged. Having a small quantity of semi-fluid metal in your cloth, begin to work it about the bottom of the joint and up the sides.

* From the *Plumber's Trade Journal.*

Here the cloth is well illustrated in Fig. 50. It shows it being worked up from the bottom toward the top, which should bring a portion of the metal with it. Keep pouring on fresh metal, moving your ladle and cloth from side to side, and by degrees get the solder nice and soft; and as the metal begins to feel shaped, firm and bulky, get the shape as near as possible, taking care to have it all soft, and when it is in this shape and in a half semi-fluid setting condition, quickly put the ladle down and do not stop a second for anything, but with

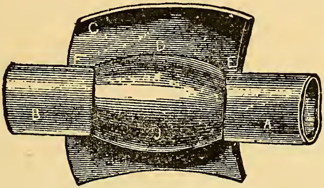


Fig. 50.*

your left hand shape this side of your joint, always beginning at the outside, or at that part next the soiling; then take your cloth in the right hand and do this side, finishing on the top; then if you have a small joint, say up to 2 inches, and have been quick with your solder, it will not be set; then give the cloth a light run all round your joint and this will make it look like a turned joint. If it is not quite clean rub a little tallow round it and wipe it with a piece of clean rag, or a damp sponge will answer instead of the tallow and rag.

* From the *Plumber's Trade Journal.*

Some plumbers, after they have shaped the joint, roughly bulge the cloth (as shown at J in Fig. 51, as held

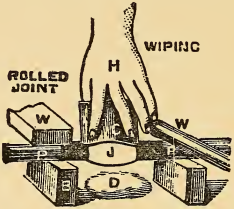


Fig. 51.*

for wiping a rolled and upright joint) and wipe or finish off the joint.

THE PREPARATION OF BRANCH JOINTS.

Branch joints are all those joints which are not made end to end, and are known as square and slope joints.

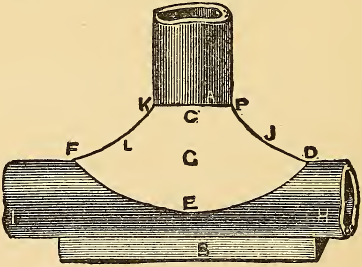


Fig. 52.

To make a square joint (Fig. 52), bore a hole with a ½-inch gimlet, or a tap borer, taking care not to go

* From the *Plumber's Trade Journal.*

through on the opposite side of the pipe; then take your bending-pin, insert it into the hole, and, by striking it upward with the hammer, raise up the edge of the hole all around, leaving no burr inside. This is done to thicken the lead at the joint sufficiently to enable the end which is to be inserted to fit without projecting into the pipe and causing obstruction, as shown at B Q (Fig. 53). When you have hammered the edge of the

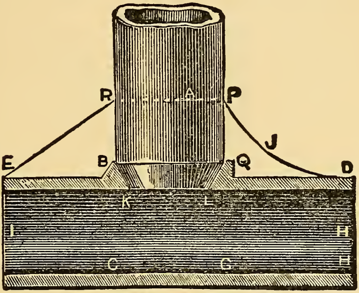


Fig. 53.

hole to the right size, go to work and prepare the male end, just as you did for the joint previously described; soil and shave it; but it does not require to be shaved so high as for an end-to-end joint—about 1 inch from the rasped end is sufficient. Now clean, soil, and shave the pipe to which the end is to be joined. Then proceed thus (see Fig. 52). If making the joint on the floor, stand with one foot on each side of the pipe at the end marked F; take the solder, and with the splash-stick

splash all around the top part of the joint at K P, also around F D; keep at this, as the solder hangs together, until you have shaped the joint as well as you can with the splash-stick; the heat may be kept up by splashing an inch or so beyond the shaving on to the soiling; the solder will not stick there, but it will aid in heating. The solder on the joint being now in a semi-fluid condi-

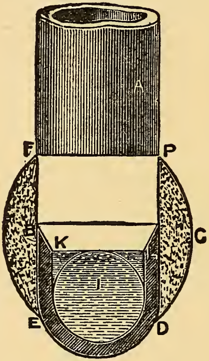


Fig. 54.

tion, you will take the cloth, already warmed by your helper, and proceed to wipe all around the top and left-hand side of the joint, then around the bottom and centre part; bring this round to the line F K; next take the cloth in your right hand, and, as quickly as possible, wipe the other side in the same manner.

Fig. 54, which is a section, shows how the joint should

be when finished ; the bulging part on each side shows the amount of and distribution of the solder.

Fig. 55 is a slope, or inclined joint. To make it, prepare just as you did the square joint, except, of course, that it must be shaped, as to the end and the hole, in accordance with the required angle ; splash it as you did before, and, when wiping, shape the acute-angled side first, as from P to D. If you cannot get into it with your fingers, which will be the case when the angle is

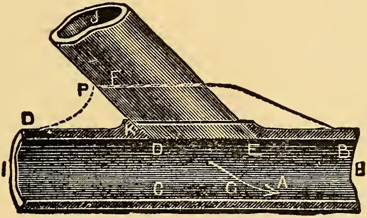


Fig. 55.

small, you must make what is called a solder-mop, by tying a piece of cloth on the end of a stick of suitable size, and use that. Then finish the two sides the same as before. The distribution of solder should be the same as shown in the section.

TAFT JOINTS.

What are known as "taft joints" are somewhat sneered at by the average plumber because they are easy to make. For all that, they make a good joint when

well made. The process is similar to that employed in making a copper-bolt joint, except that the female end is spread open very much wider (see Fig. 56). The taft joint has some advantages. In the first place, it takes less solder; in the second place, nearly any kind of solder will do.

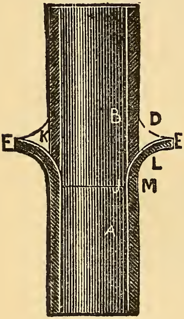


Fig. 56.

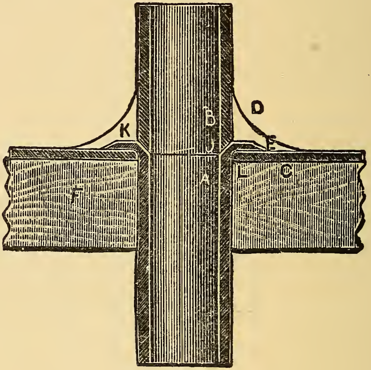


Fig. 57.

A flange taft joint is just the same in principle; the difference lies in the use of a flange (like a washer) of lead placed on the floor where the pipe passes through (F), fixed around the pipe merely for the purpose of making a more extended joint.

Taft and flange joints were used a great deal in Europe for leaden soil-pipes.

MAKING JOINTS WITH A BLAST-TORCH.

Joints are sometimes made without the melting-pot, ladle, or irons. Fig. 58 shows how the job is done. P P are the two pieces of pipe fixed for jointing at J, where the joint is shown, shaped with the torch-flame

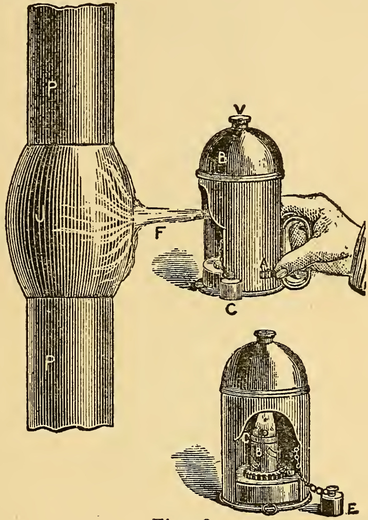


Fig. 58.

F against it. The joint is made by taking a strip of solder—say 1 inch by ⅜—and about a foot in length, and by holding the end of it against the joint and allowing the torch-flame to play upon it, enough solder is melted off, little by little, to form the joint. The joint can be almost completely shaped with the end of the

stick of solder. When you have deposited enough solder, heat it all around until you can wipe it with a cloth, and finish as any other wiped joint.

Thus far our joints and soldering operations have been supposed to be for new work only. The plumber, how-

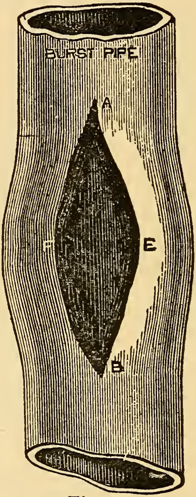


Fig. 59.

ever, is called upon very, yes, *very* frequently, to make repairs. The most common cause of the necessity of repairing is frost, which bursts the pipes, the bursting being caused by expansion.

Ice always occupies more room than the water of which it is composed ($\frac{1}{12}$ more space).

To repair a break or burst, such as is shown in Fig. 59:

first shut off the water, and see that the pipe to be repaired is clear; then gently and gradually hammer the two sides of the hole together. Keep on tapping with the hammer until the pipe looks as it did before the break occurred. Soil it all around above and below the slit, as far as is necessary; then shave it, and after a little grease has been applied, go ahead and splash it as you would for a joint; then wipe the solder, and the pipe is as good as ever, provided the work is well done.

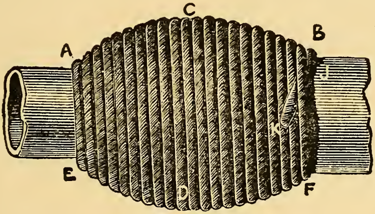


Fig. 60.

It saves putting in a new length of pipe and the making of one joint.

Never try to repair an iron, copper, or brass pipe with solder in this manner, unless for a mere temporary makeshift. If you find a break where it is utterly impossible to use solder, repair it with a putty joint, which will answer until a new pipe can be put in. Make your putty of dry or powdered red-lead and gold-size, or japan; dry the pipe thoroughly, plaster on the putty, and bind it all over with string carefully, as shown in Fig. 60.

SOLDERING ACID.

This is called also "killed spirits," and is made of hydrochloric acid, which is muriatic acid by another name. Pour some of the acid into an old cup, and put into it some small pieces of zinc. It will boil furiously for a while, but will gradually simmer down, until it has consumed all the zinc it is capable of holding in solution. It is now chloride of zinc, and is applied to the work to be soldered with a brush made of a few bristles tied together for the purpose.

Fig. 61.

When making this acid be careful to keep your tools away from it, as it splutters while boiling and rusts everything.

We mention soldering acid here because it will be very useful in making elbows or throated bends. These are very simple to make and need no extended description. The whole art consists in cutting a V-shaped piece out of the pipe of the proper size to produce the required angle (see Fig. 61).

If you want a square elbow, make the top of the

V-cut twice as wide as the pipe is in diameter, as shown in Fig. 62.

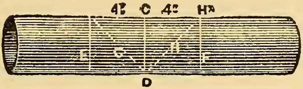


Fig. 62.

To lay out your V-cut for any angle, study the cut below (Fig. 63). Having decided upon the angle you

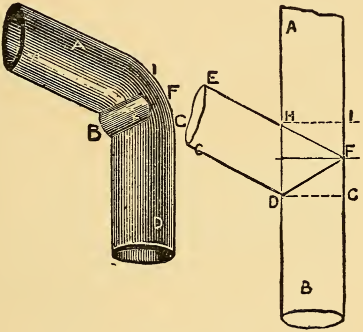


Fig. 63.

want, take your compasses and rule, and supposing you are using 4-inch pipe, lay off two sets of parallel lines 4 inches apart which shall represent the pipe, and lay them at the required angle, then the width of the V-cut will be the distance from D to H. This system is very simple, and will answer for every angle but a right angle.

BENDS.

It looks very easy to bend a pipe, but it is not. The sure result of an attempt to bend a pipe without knowing how to do it, is to buckle it, which spoils it altogether. All sorts of devices have been invented to prevent the buckling. We have seen brass pipe filled with melted resin and bent when cold, the resin being melted out again after the bend is made, sometimes the resin is left in. Sand is used for the same purpose, and is the best; balls or bobbins are also used.

Fig. 64.*

The Billings pipe-bender holds the pipe securely from buckling, but is hard to get out after the bend is made (see Fig. 64). The *modus operandi* is as follows: Insert the bender into the pipe (or thread a rope through and pull it in) to the point where the bend is to be, now go ahead and bend the pipe around any object which will produce the correct radius and the job is done. Pull out the bender with the rope.

SPLIT BENDS.

Large thin pipes require bending in a different manner, or they will gain too much metal on the inside of the bend at the expense of the outside. We

* From the *Plumber's Trade Journal.*

therefore resort to the split bend, which is prepared by cutting the pipe into halves down to the point where the bend is to commence (see Fig. 65, which shows the

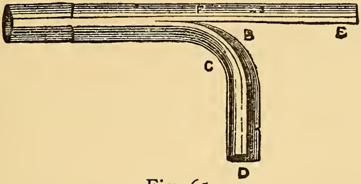


Fig. 65.

inside turned down and ready for the upper half). Each half must be bent slowly and shaped with the bossing-stick or dresser (both are necessary). See that the edges

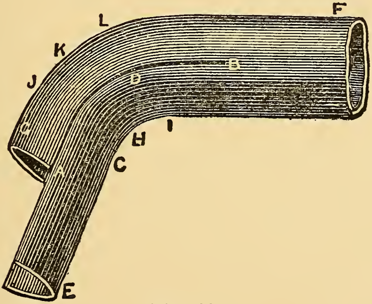


Fig. 66.

fit as closely as possible, file off all projections and solder the joints. The bend now has a piece of spare metal (Fig. 66), which is shown from A to E, and is

exactly equal to the amount of metal which would have been thrown into the inside of the bend at H, and taken from the outside at J, K, L, had you bent the pipe successfully without slitting it. You are not likely to be called upon to make such bends very often; they are generally used for lead soil-pipe.

As iron is now almost entirely used for soil-pipe, the bends, of all shapes, come ready-made.

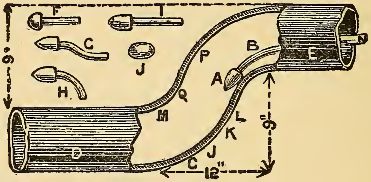


Fig. 67.

SET-OFF BENDS.

Set-offs are double bends (see Fig. 67). Always make the bend on the end of the pipe which is to be the longest first, then make the second bend. Bend the first nearly square, as it will surely come back to where you want it while you are pulling back the second bend.

The tools shown in the same drawing are for use in shaping the bend from the inside to keep it round; they are called dummies.

PART VI.

TRAPS.

TRAPS are designed to fulfil the important mission of keeping sewer gas out of the dwelling. Upon the trap depends the health of the inmates, their protection from diseases, the germs of which proceed from the sewer, and which it needs no argument to convince any one must be kept out.

Technically speaking, a trap is a contrivance which enables water, which is denser than gas, to be interposed between the sewer and the dwelling, thereby preventing the entrance of gases.

The principle of the trap is that of the inverted siphon, so arranged with a vent that all the water desired will pass through except the last larger or smaller quantity, which is equal in volume to the cubic measurement of the capacity of the trap, which is caught and retained until the next time it is used.

The drawing (Fig. 68) will show the meaning plainly. The trap is what is known as a siphon-trap; the water is seen retained level with the lower side of outlet pipe at A, while the inside of the bend at C is seen to project

into the water, manifestly sealing the trap against the passage of gas from A to B.

In order to at once show the difference between a siphon and a ∪-trap, we also give a cut of the latter (Fig. 69). There are many advocates of both styles, and the evidence seems to be in favor of the siphon. The ∪-trap possesses at least one very undesirable feature in the foul air barrier at A, which is out of sight

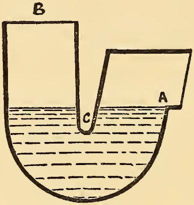


Fig. 68.

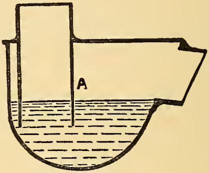


Fig. 69.

and liable to become corroded and eaten without the fact becoming known until much harm has been done.

There are endless varieties of traps, the names of which it is not necessary to give. The principal traps are the anti-∪ trap, bag-trap, ball-trap, bell-trap, bottle-trap, cistern-trap, ∪-trap, grease-trap, gully-trap, half-∽-trap, hunch-trap, ⊢∪-trap, running-trap, ∽-trap, semi-∪ trap, siphon-trap, sink-trap, and V-trap.

They are nearly all worked on the same principle; that is to say, water is depended upon to form the seal.

"Once upon a time," as the story-books say, there was such a thing as a brick-trap, which served perhaps for a dozen or so pipes at once.

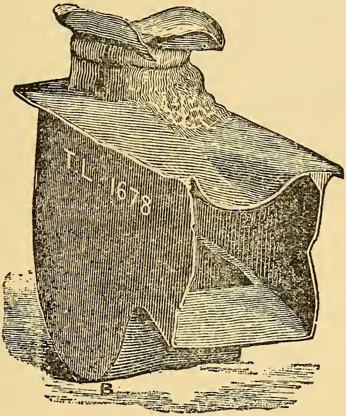


Fig. 70.*

For the sake of curiosity a drawing is here given (Fig. 70) of a leaden U-trap taken out of Lethbury's old church in England, which was in constant use over 200 years.

* From the *Plumber's Trade Journal.*

The simplest trap is the half-ℌ trap, shown in Fig. 71. It is really an inverted siphon. It is cast in one piece of lead, or it can be made by bending a piece of

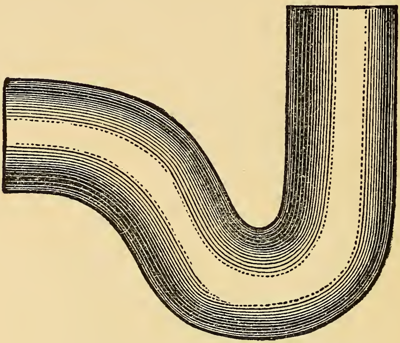


Fig. 71.

pipe into the correct shape. When provided with a screw at the bottom of the bend, as in Fig. 72, it is serviceable for sinks, etc., but not for closets.

The same trap is made in cast-iron, for use with soil-pipe work; there is an opening in the top for the vent, without which the trap would, by virtue of siphonic action, empty itself entirely.

As the plumber is nowadays seldom called upon to make a trap (they can be bought cheaper ready-made), we will simply give directions for making a V-trap, and

confine ourselves to a description of such others as are in general use.

The V-trap, which is really an ഗ -trap made in another manner, is hardly as good as the ↄ-trap in use; but it

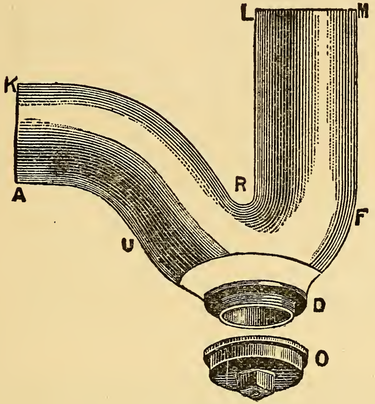


Fig. 72.

is the best to make for practice. It is here shown complete, soldering, soiling, and all (Fig. 73).

For a 9-inch trap open the compasses 4½ inches, and strike the circle A (Fig. 74); then draw the top line, B, then the back, or heel line, E, making the line E square with the line B. Now with your compasses measure from E to the opposite side of the circle, at its extreme point, and mark off this distance at R; then draw the

line T from R to the edge of the circle, to which it forms a tangent. Next draw the line V V, which should be

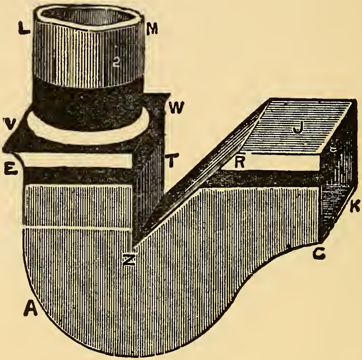


Fig. 73.

5½ inches below the top line B, and parallel to it; then draw the throat-line W. Mark off 4 inches from it along

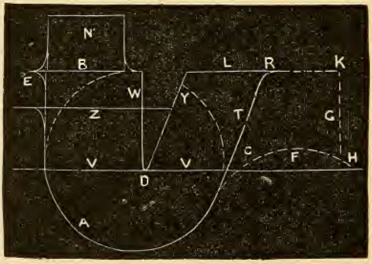


Fig. 74.

the top line B, and draw the line Y, which will meet the line W at D, forming a V, from whence the name. The

band you can make easily, as it is straight. The top, however, is cut to the shape shown in Fig. 75. B is the inlet part, C the throat part, and A the end over the outlet, which is at G, in Fig. 74, and which must be left of such a length as to reach to R, or beyond a little.

Having cut out the two cheeks, the band, and the top piece, you will prepare them for soldering. Soil the inside edges of the cheeks, then shave the inside edges of the cheeks and band and solder them together. Next shave the inside part up the throat and inlet, and

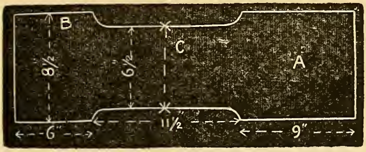


Fig. 75.

then around the outside of the inlet and top of the outlet. Next shave all around the top—about 1 inch will do. Now bend the top to fit the V, making the bend, as shown by the dotted line and two stars; place it in the V, and solder up one side, being careful that the other side is in its position snugly; then solder the other side. Now bend over the ends each way and solder them up.

When you can make such a trap as has been described, you will be able to make any other kind which can be made by hand.

We now proceed to describe the traps which you will in all probability be called upon to put in.

The Bower sewer-gas trap is a good specimen of a trap, designed to interpose a large quantity of water between the inlet and outlet pipe.

The trap is not alone sealed perfectly by the water, but also in a measure by a hollow ball. The ball can be dispensed with entirely, and the trap is equally good.

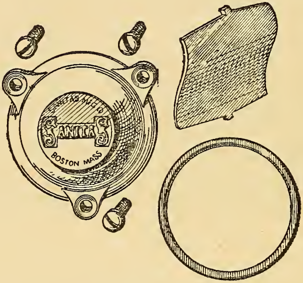


Fig. 76.

SANITAS TRAP-CUP, PARTITION, AND WASHER.

In falling the water pushes away the ball, which is of such a size that as soon as the water has passed through, it again places itself against the end of the inlet pipe, which is continued to a point midway between the normal level and the bottom of the trap. This trap has an advantage, in that it can be taken apart, cleaned out, and put together again. The principle is shown in Figs. 93, 94, and 95.

Before going any further, we must call attention to the fact that traps which hold much water are of no use unless the water supply is sufficient to thoroughly operate them. Remember that after being used nothing should remain in the trap but clean water.

Figs. 76 and 77 show the Sanitas trap, which is a

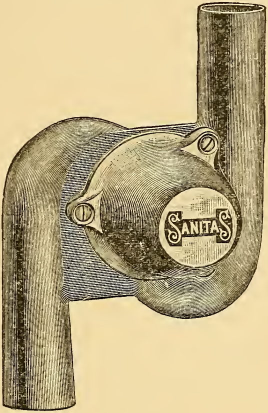


Fig. 77.

SANITAS FULL S-TRAP.

trap designed to retain its seal without a vent. We cannot do better than make use of the manufacturers' own words in describing it. They say:

"The seal of the unvented Sanitas trap never can be and never has been destroyed by siphonage in good plumbing work. Furthermore, the unvented Sanitas

trap will stand a severer test of siphoning action than will the vented S-trap. This has been demonstrated over and over again, and the demonstration can be repeated at any time to the satisfaction of any who are interested, provided care be taken to vent the S-trap in a manner which is practical in plumbing, using a vent-pipe of the size, length, and average number of bends found in ordinary practice. The seal of the Sanitas trap will be lowered by severe siphoning action, but it cannot be broken.

"The trap can be clogged by matches or kitchen refuse, if improperly used, just as can any ordinary waste-pipe; but when properly set and used, the Sanitas trap will never become clogged to the point of losing its effectiveness. If improperly used, as when under kitchen sinks the cook takes out the sink-strainer and sweeps into the trap bones and refuse never intended for the waste-pipe, the Sanitas trap will be fouled; but it then has the great advantage over all others of providing the easiest and safest means of removing this refuse matter, and that with the aid of an ordinary screwdriver. When used under sinks, the trap should be placed close to the sink outlet, and the sink-strainer should never be removed. The grease will then pass through the trap in a liquid state, and be caught in the suitable grease receptacle beyond. The efficiency of the Sanitas trap will then remain intact indefinitely, while other traps, like the old-fashioned 'D' trap, or its modern representatives, the

'Bottle,' 'Round,' and 'Pot' traps, have bodies so much larger than their inlet and outlet arms, that the grease is cooled in the large body of water they contain, and congealed against their sides, and they obviously cannot be scoured by the water when it passes through them.

"It is often thought that where special trap vent-pipes are called for, the Sanitas trap is not needed. Precisely the opposite is the fact. All sanitarians now admit that whether the trap vent-pipe be used or not, the trap itself should be anti-siphonic, since the vent alone cannot always be relied upon. The mouth of the vent-pipe is often clogged under sinks by grease, since it is never scoured, and the friction due to its bends and to the disproportion between its capacity and its length, often destroys its efficiency as an air supply. The Sanitas trap is so constructed that its seal cannot be injured by evaporation produced by trap venting. Therefore, where trap vent-pipes are called for, the use of the Sanitas trap is particularly necessary. In virtue of the peculiar construction of the Sanitas trap its outlet-pipe forms its own vent-pipe, which is infinitely better than a special vent-pipe, inasmuch as it is always kept open by the scouring action of its own discharges. But even if it should ever become closed by grease, no harm could come in this case, since the same closure would not only shut off sewer gas and siphonage, but also at once announce itself and be removed.

"Finally, the seal of this trap can never be destroyed

by back pressure, in properly arranged plumbing. For with the main soil-pipe vented as it should be, no back pressure can be generated strong enough to do mischief,

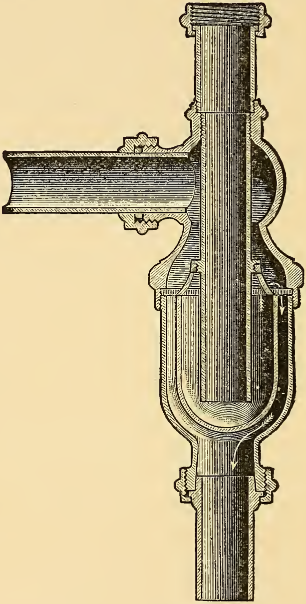


Fig. 78.

BEAUMONT BRASS TRAP FOR LAVATORIES.

where ordinary care and intelligence are used in originally laying out the work."

Figure 78 shows Beaumont's brass trap, designed

especially for use in lavatories where the plumbing is exposed. Its action is that of the bottle-trap, but the construction is such that it presents a very sightly appearance, and is especially adapted for the better class of plumbing, where fittings are left exposed to view. The parts of the trap are easily taken apart and put together, and the mechanical construction of the trap is very simple; it is easily disconnected and opened for cleaning, although its construction is such that it is not liable to clog, and hence will rarely require to be cleaned out.

The back-air and waste couplings are in the same centres in a vertical line, which is not only of much convenience to the plumber when setting, but the arrangement adds also greatly to the ornamental appearance of a lavatory. It allows ample room to run the supply pipes straight up from the floor.

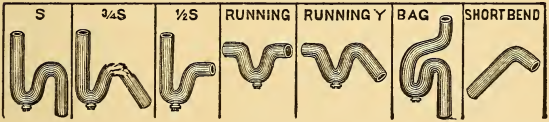


Fig. 79.

DU BOIS TRAPS.

These traps are precisely the same as any other traps of the same shape (see Fig. 79). Their merit consists in being drawn instead of cast. They are made under hydraulic pressure, the lead, as a result, being perfectly

homogeneous, there being no roughness or sand holes.

The D-trap, which is shown in Fig. 80, is a fair sample of such a trap. Its interior is shown in Fig. 69. It was much used in England prior to the discovery of improved methods of sealing against sewer gas. The same objections obtain against this trap as against the hunch

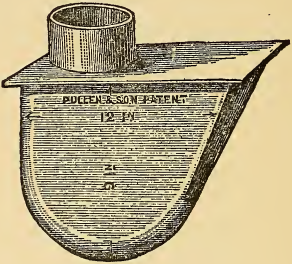


Fig. 80.

THE D-TRAP.

trap (Fig. 81), or the Adee trap (Fig. 82). Such a trap soon becomes very foul, for the reason that it is not thoroughly cleansed out by the passage of water. Anything heavy finding its way into this trap is pretty sure to remain in it, because the water, not being confined within a passageway of equal diameter throughout, is unable to act efficiently for scouring purposes.

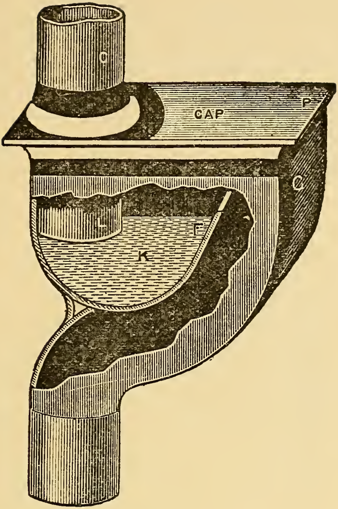


Fig. 81.

ᗜ HUNCH TRAP.

This trap is made, or rather was made, for it is not used much now, for placing in a perpendicular line of pipe ; it acts the same as an ᔕ-trap (see Fig. 81). It is also similar in action to the bag trap.

In the light of modern advance in plumbing such a clumsy, bulky trap appears out of place, as does also its congener (Fig. 82). It will be seen at once that it requires but a bend in the outlet pipe S in Fig. 82 to make it precisely the same as the ᗜ hunch trap. It, however,

possesses an advantage in the fact that it holds a great deal more water than the latter. Either of these traps are objectionable, for the reason that the interior surfaces are not, and cannot be, thoroughly scoured by the water which passes through them. This is the point which constitutes the superior feature of traps whose diameter is equal all through their interior.

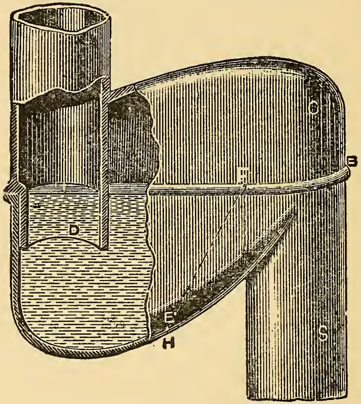


Fig. 82.

THE ADEE TRAP.

Although the Adee trap does not look like a U trap, it acts in precisely the same manner. Its principal difference is that it is cast in two pieces and joined together at B (Fig. 82).

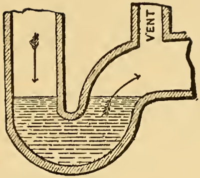


Fig. 83.

P OR HALF-S TRAP.

This is a cast lead trap, and is shown with vent attached.

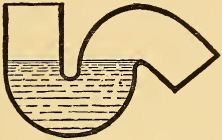


Fig. 84.

THREE-QUARTER S-TRAP OF CAST LEAD.

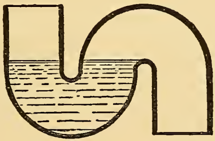


Fig. 85.

S-TRAP OF CAST LEAD.

It will be readily seen that the three preceding traps are precisely similar in action, they differ only in shape.

BELL TRAPS.

Bell traps are designed specially for sinks. In spite of the fact that they are very unsatisfactory they are

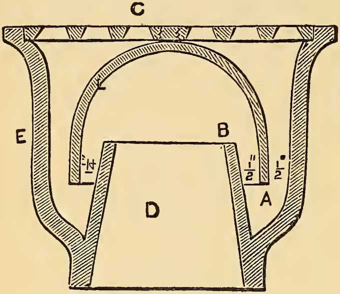


Fig. 86.

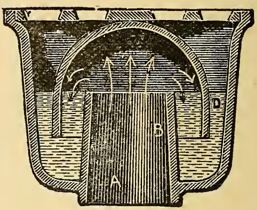


Fig. 87.

much used. The way they operate is fully shown in the diagrams Fig. 86 and Fig. 87.

ANTILL'S TRAP.

This trap was designed to take the place of the Bell trap. It is, however, but little better (Fig. 88).

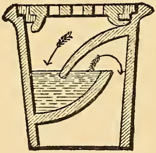


Fig. 88.

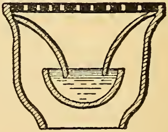


Fig. 89.

Then came Jennings with another variation on the same Bell trap (Fig. 89), which merely turned it upside down, so far as the bell is concerned.

The trap which is used on nearly every sink in New York is the S or half-S trap, with a screw in the bot-

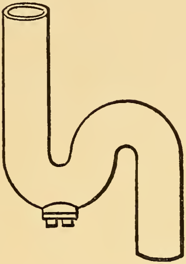


Fig. 90.

tom (Fig. 90), which can be removed for the purpose of enabling the trap to be cleaned.

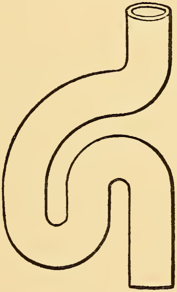


Fig. 91.

THE BAG TRAP.

The bag trap is so called from its appearance ; it presents no advantage whatever over the S-trap. Its purpose is to bring both inlet and outlet in line.

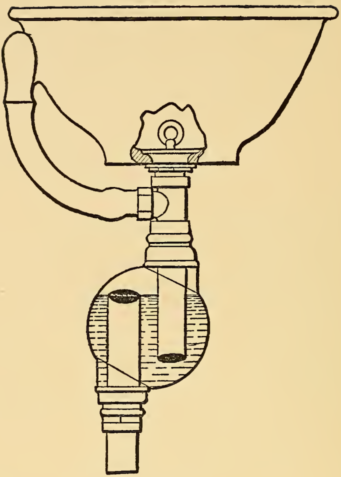


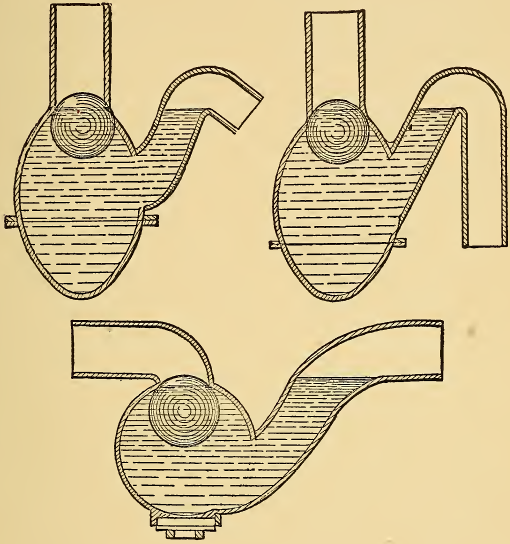
Fig. 92.

CONNOLLY'S GLASS TRAP.

Connolly's trap is shown attached to a wash-bowl. The only advantage it seems to possess is, that you can see by means of the glass globe whether the water remains in it and maintains the seal. In other respects it does not differ from an ordinary bottle trap, and its transparency is soon dimmed unless frequently and thoroughly cleaned, as the soap and dirt held in solution by the water are deposited even upon glass in the form of a greasy scum.

To the author's mind, no trap should be used which has any unnecessary joints. The less joints the better.

Mr. Paul Gerhard has made many suggestions as improvements on the Bower trap. We show three of them (Figs. 93, 94, and 95).



Figs. 93, 94, 95.

There is one point about these traps with ball-valves that recommends them, and it is this: The ball acts very much as a cork, and prevents evaporation to a great extent. The chief objection to most traps is that they will become dry in a short time.

A family away from their house during the summer months, come home; some are taken sick; no one seems to think of the cause, which is usually to be found in the fact that the traps are all dry, and have allowed the gas which exhales from the main trap and from the soil-pipe to permeate the house.

There is but one effectual way of preventing this. *Before you go away with your family, fill every trap in the house with glycerine or crude oil.* Either is cheaper than the doctor.

THE PRINCIPLE OF SIPHONAGE IN TRAPS.

The reason why siphonage takes place in S-traps is on account of the difference in the weight of the water between the inlet and the outlet of the trap, which will be readily understood on reference to the illustration. Here A is the inlet, C the outlet, and B the air-pipe. Suppose that the trap is full of water from the piston R to the piston Q, and up to the gauge-line 3 in the inlet-pipe A; and that the water in A is in a state of rest, and open to the atmosphere, which presses upon the surface of the water with a pressure equal to 15 lbs. on the square inch, and that this atmospheric pressure is also acting upon the outward end of the pistons Q and R. The pressure being equal, and, so long as the piston R is held up with sufficient weight to balance the column, the water in the inlet-pipes, A and B, will stand at one level. But suppose we add an extra pressure of 2 lbs.

to the square inch to the piston Q, at the same time keeping the piston R stationary; this will cause the piston Q to descend when the extra pressure given to the water in B and A will overcome the 15 lbs. external atmospheric pressure, and the water in the inlet-pipe will rise up to the line 5, because each division is 2 feet distant. Now, supposing each division of the pipe A to be 2 feet apart, it is then plain that the water must necessarily rise to the above level, because we will say, in round numbers (which is near enough for our purpose), that the pressure or weight at the bottom of a column of water 1 foot in height is half a pound.

This is what is meant by 15 lbs. atmospheric pressure to the 30-foot column of water; and, as before stated, the pressure of the atmosphere, as every one should know, equals about 15 lbs. to the square inch upon the earth's surface. Now, pull the bottom of the piston Q, which is now, say at line 1 up to the gauge-line 5, which produces an 8-foot column of water in pipe B above that in A. By so doing you take a portion of the weight of the atmosphere away from the surface of the water in pipe B—this represents the sucking action before explained—causing the external atmospheric pressure in the pipe A to press the water down to the gauge-line 1, and to keep it there as long as the 4 lbs. or sucking action weight per square inch is taken off the surface of the water in pipe B, or held off from the bottom of the piston Q.

Now add an additional inward pressure to the bottom piston R, to the extent of 2 lbs. to the square inch in excess of the weight of water in the pipe C; this will cause the water in the pipe A to rise from 1 to 3. Next push the piston Q from 5 down to 3; this will cause the water in pipe A to rise to 5. Keep the piston Q stationary, and suddenly remove the piston R from the pipe C. This will, so to speak, take the prop away from the water, when it will fall, and rush forward in proportion to its height, and the air rushing in behind in proportion to this additional weight causing the difference of weight which, in reality, constitutes siphonic action.

Next place an air-tight cover, F, over the end of the pipe A, and place the end of the pipe C into water; then draw up the piston Q; this will remove the atmospheric pressure from the internal parts of the pipe; by so doing the water at the mouth of the pipe E will, by the external 15 lbs. to the square inch atmospheric pressure, known as suction, be forced up the pipe, and rise to the height of about 30 feet, or from the line G to about the dotted line F, or in proportion to the weight applied to the piston Q, or until it stands at a height of 30 feet, this being the limit of the 15 lbs. external power, or atmospheric pressure. Now pull the piston Q right out of the pipe B; then let go the piston R, and the air will rush in at the pipe B, which has become the air-pipe, and so allow the water in the pipe C to fall back to its former static or quiescent state.

It is now very plain that at that moment the pipe B in reality becomes an air-pipe; and if, instead of pulling

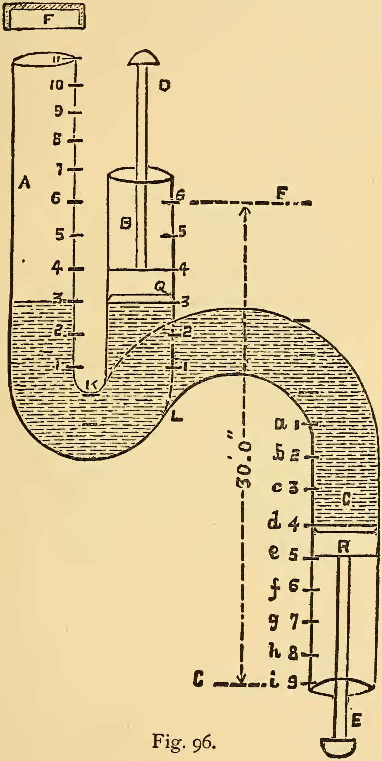


Fig. 96.

out the piston, you had taken off the cap from the top of the pipe A, this would have admitted the air, thereby

causing it to become an air-pipe, and which would have caused the water in the pipe C to have run back, plainly illustrating siphonic action.

OVAL LIP-TRAPS.

The only object apparently gained in these traps is economy of space. The one shown in Fig. 97 is designed

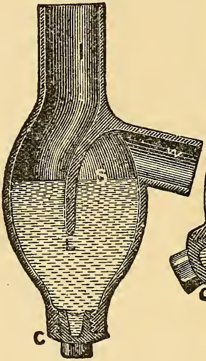


Fig. 97.

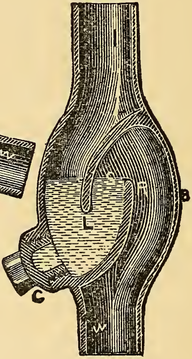


Fig. 98.

for a side outlet at W, the inlet being at I. The other, Fig. 98, has its outlet in a line with the inlet-pipe; its internal arrangements are, therefore, more crowded, and the amount of water contained at L is much smaller.

GREASE-TRAPS.

The grease-trap is very far from having reached a state of perfection. If fat would not congeal there would be no necessity for a grease-trap; but, unfortunately, the thing which causes more stoppages in the plumbing than

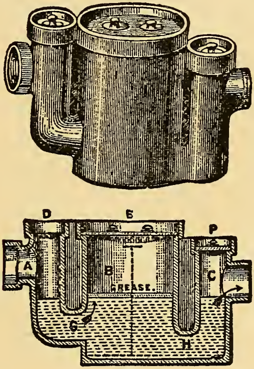


Fig. 99.

anything else is the grease which is carelessly allowed to run into the pipes, there to stick layer after layer, until they are closed up entirely.

The grease-trap partly obviates the difficulty. Whatever kind of trap is used it should be of good size, the reason being that it must hold a good quantity of cold

water in order to solidify the grease as fast as it enters.

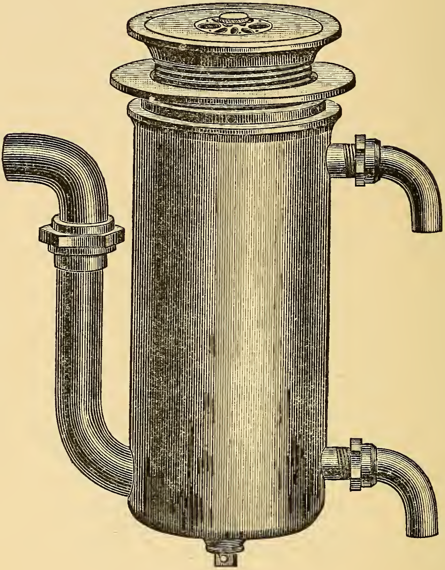


Fig. 100.*

Buchan's grease-trap is illustrated in perspective and section in Fig. 99.

Tucker's grease-trap is shown in Fig. 100.

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* From the *Plumber's Trade Journal.*

PART VII.

SOIL-PIPES.

Soil-pipe is the technical term employed by plumbers to designate the main drain of a house from the main trap, which connects with the sewer, to the roof, where it terminates.

Whether the soil-pipe should be inside or outside the dwelling admits of no argument. It *should* be outside; but climatic considerations unfortunately prevent, by reason of frost, what could be made into an almost perfect system of sanitary plumbing.

The soil-pipe is the one which suffers from niggardly economy, although it is of the utmost importance. But *it is not seen*, hence, when a plumber, by reason of strong competition, is reduced to a price for his work not commensurate with the quality to be desired, he naturally scamps the job wherever possible. He saves lead in making the joints. The soil-pipe being in many lengths, with improper joints, allows sewer-gas to escape from the joints, which have become loosened from expansion and contraction, which amounts to considerable in a stack say 60 feet high. But more of this anon.

Soil-pipes should always be of iron, and their arrange-

ment should be such as to avoid bends altogether, except, of course, the bend from the perpendicular pipe to the sewer. They are generally put in entirely out of sight, and usually inaccessible into the bargain, which is altogether wrong. Soil-pipes should be in sight. Why? For the very reason already stated—the joints. Of what avail is an elaborate system of plumbing, when the whole is rendered useless for the prevention of the entrance of sewer-gas by the soil-pipe.

Much ingenuity has been expended upon the appearance of plumbing, to the end that it may be "open." Fancy water-closets, highly finished, silver-plated pipes and traps—sometimes polished brass—all fastened to marble, etc., just for looks. But the soil-pipe, no one seems to have considered its possibilities in the line of beauty; and yet of all the devices and appliances used in plumbing, it is the very one which should be in plain sight. Steam-pipes are run all over the house—through parlors, bedrooms, etc., and no one appears to object to them very seriously, so long as a coat of bronze powder is put on occasionally. Surely a soil-pipe could be rendered equally attractive; or, since it must be out of sight, why is it not invariably encased in a wooden recess, the front of which could be easily removed by taking out a few screws.

All soil, air, and waste pipes must not only be water-tight, but air-tight as well, which leads us to remark that the water-test, as applied to soil-pipes, is of no earthly

use so far as the latter consideration is concerned. Nor is the water-test just what it should be, even for water-leaking, for the reason that the pressure is distributed very unevenly; the lower sections of pipes get a great deal the most testing, the pressure in the topmost sections amounting to nothing in comparison.

The soil-pipe should be the same diameter all the way to its end above the roof. It must have no dead ends. The extension above the roof should never be less than two feet, and the further the end can be placed from skylights, chimneys, or ventilators, the better.

All the ends of pipes above the roof should be left wide open. In New York, a return bend is used which is objectionable,* and for which there is no reason, unless to keep out the rain, which is no reason at all. All sorts of ventilating devices have been invented for use on soil-pipe ends, but nothing equals the plain open end.

Just as much attention should be paid to the joints of the air-pipes as to those of the soil-pipes. As they are placed in the system between the water-seal in the trap and the soil-pipe, it stands to reason they must carry off large quantities of foul gases, besides serving as a vent for the traps to prevent their being entirely emptied of water. Air-pipes are better carried through to the roof, although they are frequently joined to the

* This has since been done away with.

soil-pipe above the highest fixture. We do not recommend the latter plan.

When putting in soil-pipes it is necessary, of course, to insert a Y or a T branch at each floor, or wherever it is wanted.

An elbow of wide radius should be used where the upright stack diverges into the portion which runs to the main trap, and which is, comparatively speaking, horizontal (it has a fall of at least ¼ inch to the foot). As the stack is naturally very heavy, it follows that it should have a strong support; a brick pier is the best.

From the elbow to the sewer-trap the soil-pipe, or main drain as it is known, should be kept in plain sight. It is usual to suspend it along the cellar wall, or with hangers from the ceiling if the stack does not terminate near a side wall. Of course if there are any sinks or water-closets, or other fixtures in the cellar, the main drain must go still lower, and, if necessary, below the cellar floor level; but no matter where it is, it should be where it can be seen.

The main drain should not exceed 6 inches in diameter (the stack 5 inches for a large house); for a small house, a smaller size drain,—a drain 4 or 5 inches,—will answer. It should not deviate from a straight line, but if a curve cannot be avoided, see that it is of wide radius.

The main drain should be trapped, and the trap set in a man-hole where it can be got at for cleansing purposes without much difficulty. A rain-water leader

should be made, if possible, to terminate on the house side of this trap, as it will serve to clean it out thoroughly whenever there is a rain-storm.

There now remains to be put in a fresh-air pipe, which is run from some point in the main drain back of the trap to a point in the sidewalk or garden, well removed from the windows. In New York you will notice a small iron grating set in the sidewalk near the edge, that is the fresh-air inlet placed there by direction of the Board of Health; it permits air to pass completely through the soil-pipe to its end on the roof.

Having thus generally described soil-pipes and their connection with the main drain, we will proceed to details.

CAST-IRON SOIL-PIPE.

Soil-pipes as generally used throughout the United States are made of cast-iron, each length being made with a hub and spigot end. Lead soil-pipe was used to a large extent, as also was earthenware; but both have been superseded by the cast-iron pipe, and the latter itself, as we will explain, bids fair to be soon entirely "put out of joint," as it were, by wrought-iron pipe which is screwed together. In the light of the advance which plumbing has recently made, it is not necessary to discuss the merits of any other soil-pipe except cast and wrought iron.

Cast-iron pipes are usually made in 5-foot lengths. You will notice, as you become familiar with them, that

if there are any defects they are usually to be found at the hub end of the pipe, unless in pipe over 12 inches in diameter, when the defects, if any, will be found at the spigot end. The reason is this: the smaller pipes are cast hub up, while the larger pipes are cast hub down, so that whatever sand, etc., may be floated upward in the mould by the molten metal, of course mixes with the iron in the end which is at the top in casting. It was the practice at one time to cast iron pipe in a horizontal position, but it was found in course of time that the core, the specific gravity of which was much lighter than molten iron, was bent upward in the centre by the effort of the metal to float it. The pipe cast in this manner was, therefore, thicker on one side of the centre than the other. Casting in a perpendicular position obviated this difficulty.

The following is a table showing the thickness of metal which should be in various sizes of iron soil-pipes:

2-inch pipe	....	$\frac{5}{16}$	inch thick.
3 "	....	$\frac{5}{16}$	"
4 "	.. ..	$\frac{3}{8}$	"
5 "	....	$\frac{7}{16}$	"
6 "	....	$\frac{7}{16}$ to $\frac{1}{2}$	"

Before you use a piece of such pipe, strike it with the hammer to find out if it is sound and free from cracks. If it is all right, it will give a clear, bell-like note. They must not be painted before they are put up; the paint-

ing must be left until after they have been tested in position.

When you put up cast-iron soil-pipe see that the spigot end enters fairly into the hub below it, and that the pipes are in perfect alignment; both hub and spigot must be clean. Then take twisted oakum, and with it form a gasket, which you will insert in the space between the hub and spigot; take your calking tools and mallet and ram it in well; if it is not tight you will find the lead, which follows, will run into the pipe. This gasket of oakum should fill about one-third of the space, and serves no other purpose but to hold the hot lead, which now goes in, from getting into the pipe. Now take your ladle full of melted lead (be sure you have enough to fill the joint in one pouring) and pour it in a continuous stream until the joint is full. As lead shrinks as it cools, the joint is not tight; it is therefore necessary to thoroughly pound it in with calking tools. Be careful not to overdo it, for the calking puts a tremendous strain on the hub or collar, and it might break under the pressure. The cut (Fig. 101) shows exactly how such a joint should appear in section.

The same appearance should also be presented when the joint is made with the pipes in a horizontal position. The operation of making this joint differs slightly, because the lead cannot be poured into the joint without using something to retain it. The gasket of oakum is put in, in the same manner; then, when ready for the lead,

a roll of clay is pressed all around the face of the hub, leaving an opening at the top. Pour the lead in through the opening until full; cut away the clay and surplus lead and then calk it thoroughly; don't neglect the under side because it is hard to get at.

When you have joined cast-iron pipe as described,

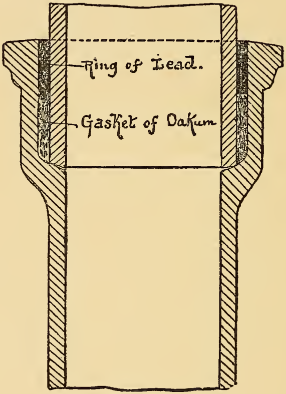


Fig. 101.

you will leave the joint as it was when you finished calking it. Use no paint or putty, but let the marks of the calking-irons show that you did not neglect that important part of the work.

The quantity of lead required for joining different sized pipes is as follows:

DIAMETER OF PIPE.	WEIGHT OF LEAD REQUIRED.	DEPTH OF LEAD IN JOINT.
2 inches	2 lbs.	1½
3 "	2¾ "	1⅝
4 "	4 "	1¾
5 "	5½ "	1⅞
6 "	7 "	2

There is another method, called the rust joint, of joining such pipes, and is much used for steam pipes. The "rust" is an iron cement, composed of iron filings or borings, flowers of sulphur, and sal-ammoniac.

A quick cement is made of:

1 part flowers of sulphur.
1 part sal-ammoniac.
98 parts iron.

A slow cement consists of:

1 part flowers of sulphur.
2 parts sal-ammoniac.
197 parts iron.

Supposing you have now got your soil-pipe into position, it remains to be tested, which is done by filling it full of water. All the ends must be stopped up, of course. You will then carefully examine every portion of the surface of the pipe for leaks; you may think because the hammer said it was sound, that it has no defects, but remember (we quote Mr. Baldwin Latham):

"There are faults to which all articles made of cast-iron are liable, and which may escape observation even after the most careful scrutiny, and, in consequence, there will ever remain a certain degree of uncertainty as to the strength of iron castings, for there are numerous instances which may, more or less, affect the quality of the manufactured article—such as unequal contraction in cooking; imperfections from latent flaws, which may be concealed by a covering of sound metal; the brittle nature of the material; the presence of some deleterious agent in the metal itself—all tending to render cast-iron more or less uncertain, and liable to fail without warning. . . . .

"The proper admixture of the iron in the foundry is one of considerable importance in order to insure a perfect casting; for, as different varieties of iron have different points of fusion and varying rates of cooling, unless a proper admixture is insured, the casting will have within itself an element tending to produce its own destruction; for, while some of the metal may be in perfect fusion, other parts may be imperfectly fused, while again others may be burned, or, in cooling, some of the metals may cool faster or slower than others, consequently the casting may be thus brought to a state of unequal tension, or, as it is technically termed, 'hide-bound,' when such slight influences as sudden change of temperature may lead to its instant destruction."

Cast-iron pipes, however, bid fair to be entirely super-

seded by wrought-iron pipes, jointed by screwing one into the other, or by the use of sleeves. It is the opinion of the author, and of the best master plumbers whom he has consulted, that this system of soil-piping must come into general use; in fact, there is no good reason why even the soldered joint should not be dispensed with too, and the screw-thread joint used for everything.

WROUGHT-IRON SOIL-PIPE.

We have already called attention to the probability that wrought-iron pipe with screwed joints is destined soon to entirely supersede cast-iron pipe with calked joints, as a soil-pipe.

In 1880, Mr. Caleb W. Durham obtained a patent, the principal claims of which were as follows:

"2. The combination, with the drain, of the vertical soil pipe, and a support therefor independent of the building substantially as specified.

"3. The combination with the rigid soil-pipe, and an independent support therefor, of the rigid branch pipe upon which the water-closet fitting is supported and secured, substantially as and for the purpose specified.

"5. The combination of the cast-water closet fitting provided with flange for the reception of the water-closet, with the rigid branch pipe, substantially as specified."

It has been erroneously supposed that this patent

covered the use of wrought-iron soil pipe and fittings. Such is not the case; there is no invention about the pipe itself, nor in fact about any portion of the arrangement. A careful reading of the claims quoted will show that Mr. Durham patented a soil-pipe system which alone, or with supports *independent* of the building in which it might be placed, supported the water-closets in such building.

With this in our minds, we easily understand what the Durham system is, viz.: a rigid soil-pipe, with equally rigid branches, upon which are set the water-closets, the whole capable of standing alone and independent of the building in which it is situated.

The above plan has been modified by others successfully, as we will explain further on. First, we will point out the merits of the wrought-iron soil-pipe itself. It is argued by a great many plumbers,—men, too, who ought to know better—that wrought-iron pipe rusts quicker than cast-iron pipe. This is perfectly true under certain circumstances, but it is not true as regards its use as a soil-pipe, as is easily proved by an examination of the interior of wrought-iron soil-pipe after extended use. It is a well-known fact that cast-iron soil-pipe acquires, after a while, a coating of insoluble grease upon its interior surface which effectually prevents rust. Now, the author has failed to find any kind of pipe which does not acquire the same coating. Wrought-iron pipe most certainly does, which shows that the rust argument

against it has been, and is, used without taking the circumstances of the case into consideration at all.

The next, and about the only other argument we have heard against wrought-iron soil-pipe, is that the screw-joints are weak. This is absolute nonsense, and proceeds only from blind prejudice. The accompanying drawing shows how the wrought-iron pipe joint is made for plumbing purposes (Fig. 102). B B B B is a fitting

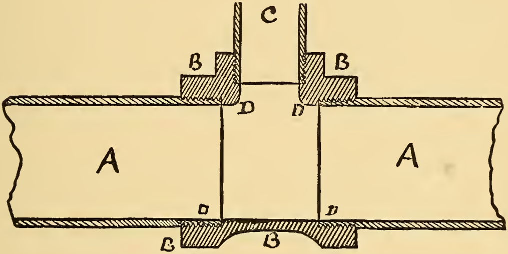


Fig. 102.

designed for a "T" joint. Its peculiarity lies in the fact that it is so constructed as to enable the ends of the pipes A A and C to butt up against a shoulder, the purpose being to afford an interior surface without a break. This is shown at D D, etc., where the pipes are seen firmly seated against the shoulders, and presenting a continuous and smooth interior.

It is at once obvious that, to accomplish this end, the screw-threads on both pipes and fitting must be straight,

—*i. e.*, not tapered, for if they were tapered there never could be any certainty of a close joint between the end of the pipe and the shoulder of the fitting. There is, however, no objection to the straight threads provided they are cut to fit.

Knowing how to make such a joint, we see at once that it is far superior to the hub and spigot joint, for the following reasons: First. If properly made, it is absolutely and *permanently* tight. Second. No amount of vibration, settling, expansion, or contraction, nor, in fact, any of the causes which usually destroy the efficacy of the hub and spigot joint, can disturb the wrought-iron joint. Third. It ensures a smooth interior, affording no lodgment for filth.

Mr. Durham, being a man of progressive ideas, saw at once that such a joint was desirable, and under the title of "The Durham House-Drainage Company," makes the pipe and fittings described for plumbing purposes.

But there was nothing patentable about all this. A result, however, of such a system of pipes and joints was, that the pipes and branches together, with the water-closets fastened to the ends of the branches, would *stand alone*, or, at any rate, could be used without any support from the building itself, and this was patented.

There is no advantage to be gained by making a soil-pipe system separate from the building; as a matter of

fact, all soil-pipes should be fastened to the wall of the building itself; then, when any settling takes place, as it surely will, the relative positions of the closets and floors are not changed. It will be readily seen that a rigid, separate soil-pipe—in other words, the Durham system—will stay up when the building settles, making it quite possible for something to break.

Taking the foregoing statements into consideration, the author would earnestly recommend the use of wrought-iron pipe and fittings; not *resting upon a support independent of the building*, but fastened to the building firmly at every floor, and forming, from a structural point of view, an integral part of it, allowing the elbow at the bottom of the stack to hang free in order that any change in height, from settling or other causes, may be compensated for by the horizontal pipe from the elbow to the main trap, which can be moved up or down at the elbow end several inches without any damage resulting.

Wrought-iron soil-pipe has been put up in the manner advocated, and was no infringement on the Durham system. The connections from the water-closets to the soil-pipe, instead of being " rigid " and of wrought-iron, as in the Durham system, were of lead pipe, joined to the wrought-iron pipe in the usual manner with a brass ferrule, which was screwed into the wrought-iron pipe and soldered to the lead pipe.

The joints of wrought-iron soil-pipe are screwed to-

gether with chain tongs; red lead and oil are used to make the joint perfect, as in gas or steam fitting.

In case of repairs rendering it necessary to replace a section of wrought-iron pipe, it becomes a matter of some difficulty to cut it, but the Durham Co. have made tools especially for the purpose, which render the operation comparatively easy.

PART VIII.

SEWER CONNECTION.

THERE is one point about soil-piping which we have left untold, viz., the sewer connection, deeming it advisable to treat the subject by itself.

Before you set to work, ascertain the depth of the sewer and the lowest point at which you can reach it for the insertion of the pipe. The authorities will make the opening. We will assume that you have plenty of fall —more than a quarter of an inch to the foot. Now, dig your trench ; if the bottom is rock or hard ground, you can lay your drain-pipes on it without preparation ; but if the ground is soft and bad, you must make an artificial bottom of concrete on which to lay the pipes, then cover them with concrete and throw in the earth.

Fig. 103 shows a sewer with the drain connected ; it also shows a valve or flap-trap.

Flap-traps are made in several ways. Fig. 104 shows Mr. Latham's balance valve. This valve has an iron ball or weight which can be so adjusted that the flap will shut, no matter at what part of the sewer it is placed. You will easily understand that if an ordinary flap were placed

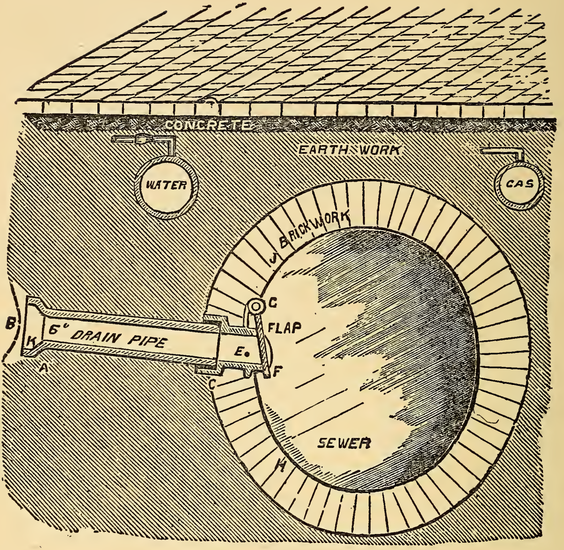


Fig. 103.

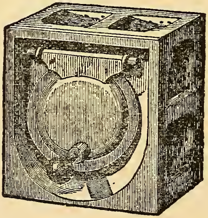


Fig. 104.

above the centre line it would naturally hang open, and be of no use.

Fig. 105 shows in elevation the drain from the elbow at the foot of the stack to the sewer, including the main or running trap, with its connection, behind the trap, for a fresh air inlet.

We have already described the water-test. There are other tests of a chemical nature, well-known to plumbers; such as the peppermint-test, or the smoke-test.

The peppermint-test is described as follows by Mr. P. J. Davies. He says:

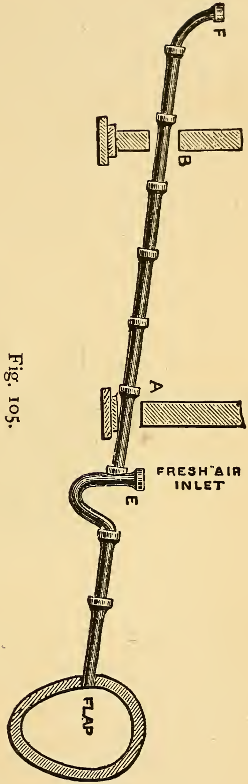


Fig. 105.

" First, if you have a fresh air inlet, stop it up, and all other openings in sight connected with the drain. Next take two or three ounces of Hotchkiss' oil of peppermint (anybody else's oil of peppermint will do as well), and see that there is not the slightest trace to be found on the outside of the bottle, or most likely this will spoil your test. Now, have about a gallon of boiling water, or sufficient

for what you think will answer to carry the chemical into your drain and go to the highest points of the soil or air pipes, and carefully pour down this pipe the peppermint, after which quickly pour down the hot water and stop up the end of the pipe. Be exceedingly careful not to spill the least traces of the peppermint about your hands, etc.; then run down through the house, and to the places which you suspect, and see if you can

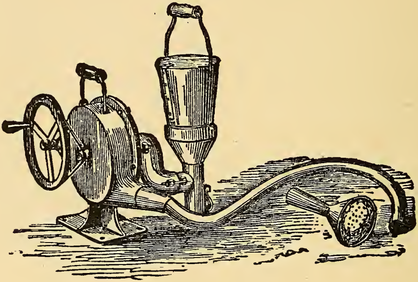


Fig. 106.

discover any traces of your oil of peppermint smell; if so, it is a certainty that something is wrong. You should have an attendant drilled in the work with you."

Mr. Davies then proceeds:

"The sulphuretted ether is applied in much the same manner as the peppermint was, but will require three times the quantity; and caution must be used not to get a light or fire near it or it will explode. It will hang

about for weeks. Oil of aniseed and nitro-benzole have about the same effect as the oil of peppermint."

THE SMOKE-TEST.

To use the smoke-test, you must have a machine for the purpose, known as the asphyxiator. Burn tobacco-paper to produce the smoke, and pump it into the main drain. If there is a leak anywhere through the house the smoke will find its way through it. Fig. 106 shows the machine.

PART IX.

VENTS.

VENTS proper are distinct from ventilation. Ventilation is provided for by the air inlet already described, which enters the main drain behind the main trap (see Fig. 137, also Fig. 105).

Vents are contrivances designed to prevent the emptying of the traps from siphonic action; this will be readily understood by referring to the drawing (Fig. 107), which shows a wash-basin properly connected. As soon as the plug G in the bottom of the wash-basin is drawn, the water will rush down the pipe A through the trap B over the arch at H and down the waste-pipe E. If there were no air vent C, the water would *all run away*, and none would remain in the trap except a very little, insufficient to maintain the seal. The discovery of this fact, called siphonage, led to the adoption of the air vent. The action is as follows:

After pulling the plug, the water runs down precisely as in the first instance, until it reaches the level of the trap's capacity at I; the water which is then rushing down the waste-pipe D, instead of drawing the water from B after it, draws air down through the vent-pipe

C, leaving the last trap full of water in the trap B. Divested of all scientific explanation, the above is precisely

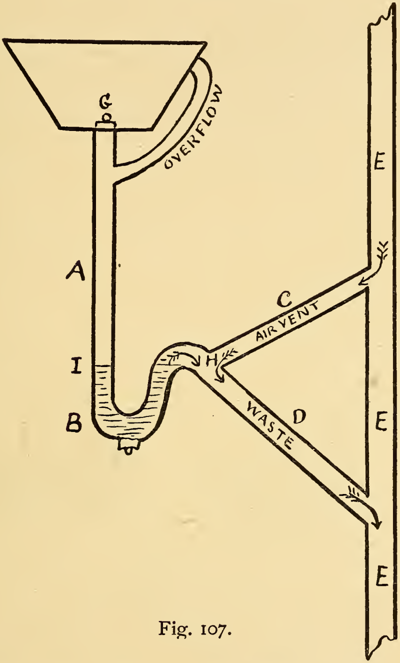


Fig. 107.

and exactly the action in every trap where a vent is used.

In practice a separate pipe is used to which the air vent is connected. Only the one pipe is shown in cut for sake of clearness.

PART X.

WATER-CLOSETS.

We now come to the most important fixture put in by the plumber, viz.: the water-closet. To select a water-closet is a difficult matter, there are so many of them, and each manufacturer will claim that his is the best. The author would recommend only those closets using the wash-out principle.

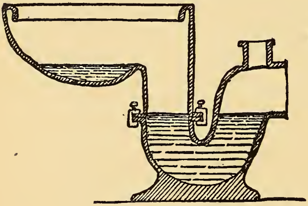


Fig. 108.

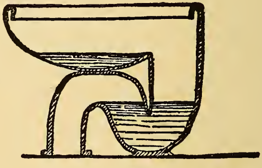


Fig. 109.

After an examination of all the closets made, it will be seen that they are really of two constructions only. First, those with machinery to be moved: such as the pan-closet (now obsolete), the valve-closet, and the plunger-closet. Second, those without any machinery except a water-pull: such as the hopper and the wash-out closet.

There is no reason why space should be occupied

with a description of closets which no sane person thinks of putting in nowadays, so we will omit them.

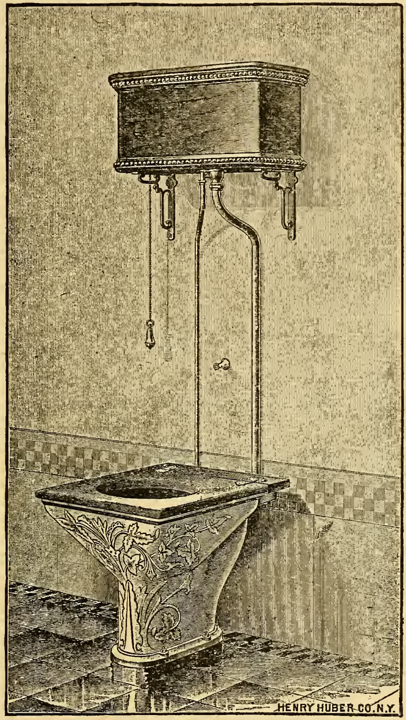


Fig. 110.

A good closet involves the principles shown in Figs. 108 and 109, designed by Mr. Paul Gerhard.

Compare the modern fixture (Fig. 110) with closets which are shown in Figs. 111, 112, 113, and which to

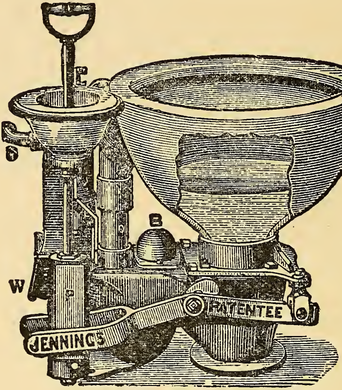


Fig. 111.

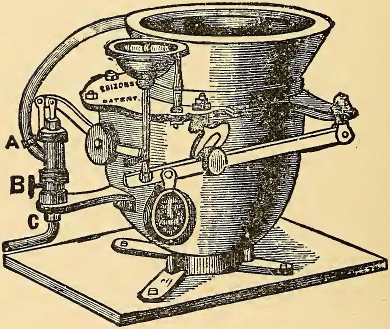


Fig. 112.

the uninitiated eye look like complicated steam-engines. All the machinery shown was necessary to operate a

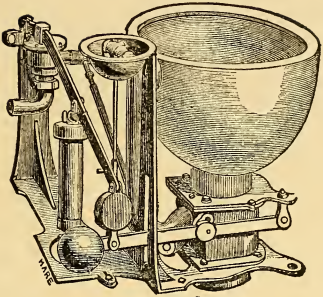


Fig. 113.

valve, or pan, or slide; neither of which was ever necessary at all, unless limited to the use of about a pint of water for flushing purposes.

THE SANITAS WATER-CLOSET.

The form of the Sanitas is very simple. The bowl and the trap are one and the same thing. There is no machinery of any kind in the closet itself; the flushing is accomplished by the pressure of the water only. The supply-pipe enters the bowl below the normal level of the water remaining therein, and stands permanently full of water up to the cistern-valve. The water is held in the pipe by atmospheric pressure, the pipe being closed at the top by the cistern-valve, and at the bottom by the water in the closet-bowl (see Fig. 115, Sanitas).

The form of the closet-bowl is such, that the surface of the water standing in it is very large. The water is

deepest at the back of the bowl, and very deep at the point where the waste strikes. All parts of the trap and bowl are easily accessible from the bowl itself.

The makers claim that this closet can be flushed with less than a gallon and a half of water, but the more water used the better. They then go on to say:

"The water does not have to fall from the cistern to the closet before it begins to work. In the second place, the friction of air in the pipe is avoided, and the water exerts at once its full power in discharging the waste matters. Hence a very considerable economy of water is the result. As already stated, the upper orifice is placed below the level of the standing water in the closet-bowl, but above the dip of the trap. This position of the upper jet gives us another very important advantage. Should the water in the closet be lowered by evaporation or siphonage below the upper orifice, air will at once enter the supply-pipe through this orifice, and water will then descend from the pipe into the closet through the lower orifice, until the upper orifice is again covered, and the seal of the trap is thus automatically maintained by the water in the supply-pipe. This pipe may be made capacious enough to restore the seal as often as it is likely ever to require it. A pipe 1½ or 2 inches in diameter and 6 feet long will contain water enough to secure the seal against destruction by evaporation for a great many months, even in the driest and hottest weather. Hence the closet may be left to itself

in city houses for the entire summer's vacation without fear on this score, and the danger of a loss of seal through siphonage is also reduced to a minimum. . . . .

"It will also be observed that the closet is provided with a cistern overflow connection, which may serve also when desired for a seat ventilation-pipe connection, by continuing the overflow-pipe above the cistern, and entering it into a suitable ventilating flue. In this case the overflow-pipe must dip into the water of the cistern and descend nearly to its bottom.

"An important advantage in having the trap and bowl of a water-closet combined in this simple form, is that they may be easily emptied in winter to prevent freezing. This is sometimes desirable in the case of summer residences which are closed up in winter. The water may be easily sponged or pumped out of this closet without taking it apart."

Figs. 114 and 115 show the Sanitas closet in position. This water-closet is very easy to set. The illustration (Fig. 116) shows its appearance when properly set, with cistern and fittings complete.

It is important that the cistern be placed directly over the water-closet, in such a manner that the supply-pipe from cistern to closet shall be vertical, and as direct as possible. Every additional bend increases the friction of the flowing water, and impairs the working of the closet, especially where the cistern has to be set low.

Any wooden cistern holding ten or more gallons of

water up to the overflow, will serve for the Sanitas closet and valve. The cistern should be of wood, of the usual make, lined with sheet metal, as customary, preferably with 16-ounce tinned copper.

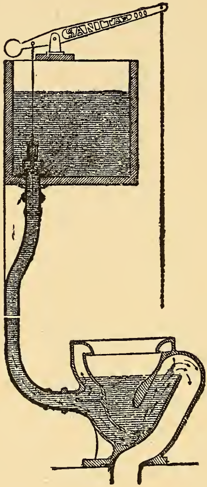


Fig. 114.

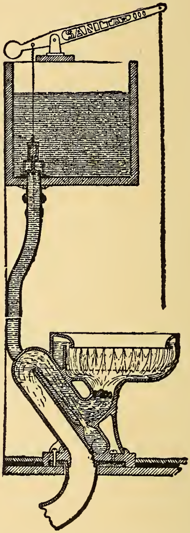


Fig. 115.

If an iron cistern be used, a hole just large enough to take the valve should be bored in its bottom before setting, and preferably before painting or enamelling. The valve must then be secured to the bottom of the cistern, using red or white lead and leather between the flange

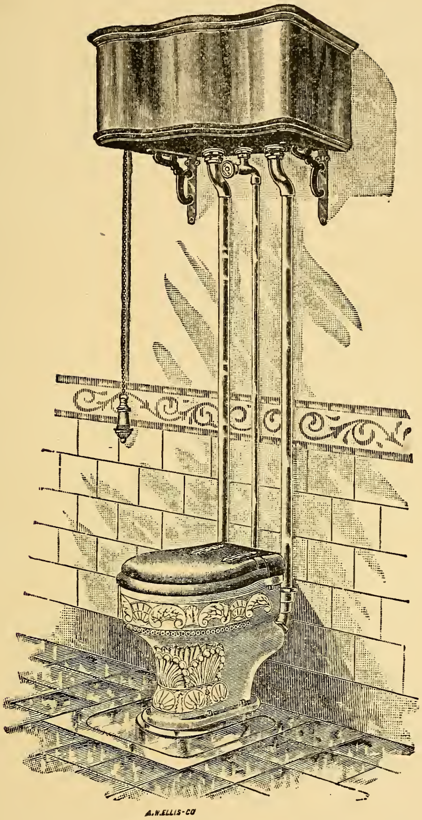


Fig. 116.

of the valve and the bottom of the cistern, to make the joint water-tight.

The bottom of the cistern should *be placed as high in the room as possible*, and not less than 7 feet above the floor on which the closet stands, with the supply-pipe straight and direct. If it is impossible to have the supply-pipe straight and direct, or in other words, to have the cistern directly over the closet, the height of the cistern should be greater than the above, in proportion to the degree of indirectness or crookedness and corresponding friction in the supply-pipe.

The supply-pipe, from cistern to water-closet, should be 1½ inches inside diameter.

The supply-pipe from the cistern to the water-closet is intended to stand permanently full of water, which is sustained in the pipe by atmospheric pressure, on the principle which sustains water in a bottle filled with water and inverted over a basin full of water. Therefore particular care should be taken by the plumber to make the connections of this pipe absolutely air as well as water tight. The smallest leak hole, especially at the upper connection, will let air into the pipe when water will not show the leak by escaping. This will allow the water to descend out of the pipe, and the operation of the closet will be injured. A want of tightness may be detected by a faint hissing noise of air rushing into the top of the pipe immediately after flushing. To hear this hissing noise it will often be necessary to hold up the

ball-cock and shut off the noise of filling the cistern, and hold the ear close to the suspected point on the pipe. Another sign by which it may be known if the supply-pipe contains air, is the bubbling noise in the water-closet bowl, occasioned by the air escaping through the water in the closet, when the flushing commences. If the pipe stands full of water, as it should, the water in the closet-bowl will descend immediately and silently, without bubbling, the instant the valve is opened.

Where a high cistern is used, the power of the flushing is sometimes so great as to lower the water in the closet-bowl below the dip of the trap, thus opening an air-passage for the escape of noise from the lower jet. A special adjusting mechanism has been added to the lower coupling, by which the strength of the flush may be regulated at pleasure, by simply turning a small screw on the coupling with an ordinary screwdriver. When the slot in the head of the adjusting screw is in a line with the length of the coupling, the flush has its maximum strength. When it is at right angles with the coupling, it has its minimum strength. It is best to place the cistern as high as possible in the room (provided the height of the room be not over 12 or 14 feet), and then regulate the power of the flush with the adjusting screw until a sufficient flush is attained without a noisy action.

This improvement of the adjusting screw greatly facilitates the setting of the closet, and enables the owner

to control the amount of flush at pleasure. When desired, he may thus render the closet so noiseless in action that, with the seat down, and the toilet-room door closed, not the slightest noise can be heard from without, and the closet can be used, off the main hall, for instance, unknown to the other occupants of the house.

Inasmuch as the water-closet supply-pipe must be kept air-tight, so as to stand always full of water, a separate overflow-pipe must be provided for the cistern. This pipe should either connect with a system of fixture or safe overflow-pipes, made for the various fixtures, or their safes in the house, as is done in some cases, or else simply connect with the closet flushing rim, as shown in the perspective, a coupling being provided on the closet for the purpose. Here any leakage will show itself at once on the sides of the bowl. It will also announce itself by a hissing noise at the ball-cock. This pipe may also serve as a seat-vent, if desired, by connecting it with a special ventilation flue above the cistern, as explained in the perspective. This vent-pipe will serve also to ventilate the entire room, and is an excellent method of ventilating a toilet-room.

SOIL-PIPE CONNECTION.

The lead pipe which is to connect the closet with the iron soil-pipe, is to be first flanged over the hole in the shoe at the floor, and the closet is then set in place on the

shoe, and screwed down by means of four brass machine screws, which are furnished with each closet. Where wrought-iron waste-pipes are used the lead connecting pipe is not needed, the closet being supported on the wrought-iron branches. The holes in the earthenware base correspond with the threaded holes tapped in the shoe, but are made a little larger than the screws, to allow of a certain amount of play for adjustment. Brass and leather washers are used to cover these holes, and protect the earthenware from injury. A red lead and putty mixture is used between the earthenware base and the shoe. The earthenware and metal then become, as it were, one piece, and the closet is thus independent of shrinkage or settling of the floors. All movement takes place in the flexible lead pipe below, which should always be used between the closet and cast-iron soil-pipe. The joint thus becomes a permanently sewer-gas tight metallic joint, which cannot be injured by jarring, settlement, or shrinkage in the building. This kind of connection is now acknowledged by sanitary engineers and plumbers as the only perfectly safe one for water-closets known. The trap vent-pipe, if used, should be connected with the lead waste-pipe, instead of with the earthenware, as this avoids all danger of cracking the earthenware, or of clogging, and is easier and tighter and safer for the plumber to connect. But the Sanitas closet does not require trap-venting.

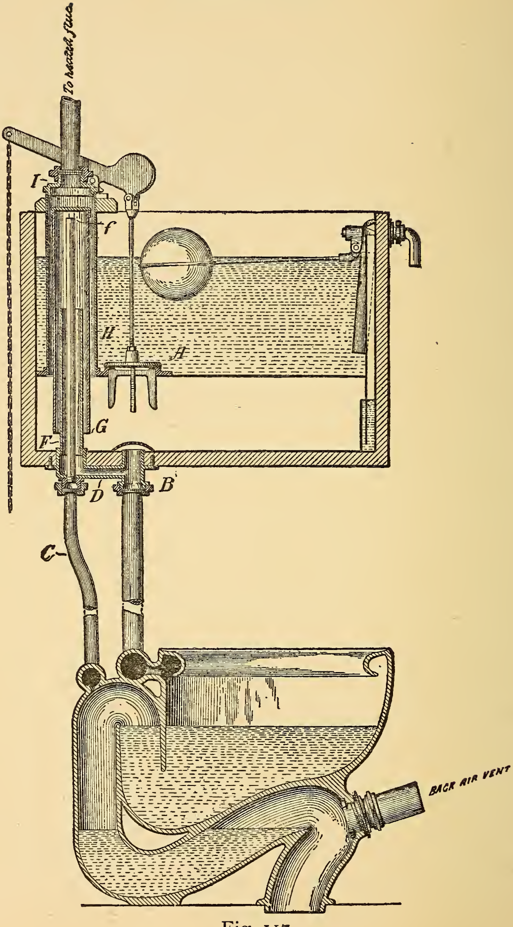


Fig. 117.

BOYLE'S PNEUMATIC CLOSET.

In 1884, James E. Boyle, a sanitary engineer, invented the system of successfully operating a water-closet in which the functions that had been assigned to a complicated arrangement of mechanical parts, should be performed by natural means—a siphon outflow started on the pneumatic principle.

Mr. Boyle's first closet was the "Tidal Wave" (he afterwards produced the "Geyser" and "Crystal"). It has a large, deep water-seal in the bowl and an additional seal of 1½ inches in a trap below it, all made in one piece of earthenware. (See sectional view on page 132.)

The cistern consists of a storage reservoir and a flushing chamber to hold a limited quantity of water, three gallons (no more being necessary to operate the closet), which is admitted through a 3½-inch valve A, when pulling the chain, and holding it for four seconds.

The flushing water passes through the injector (or trombe) B, and the flushing-pipe to the bowl, being in communication with the air-pipe C, by means of the branch D, a portion of the air is sucked by the falling water out of the air-space through the air-pipe, creating a partial vacuum in the limb of the bowl between the two water-seals. Thus the atmosphere in the room being heavier than that in the confined space, starts a siphon sufficient to empty the contents of the bowl over the dam and through the lower trap into the soil-pipe. The flow of

water through the flushing-rim is not only strong enough to thoroughly cleanse the bowl, but also sufficient in quantity to leave a perfectly clean water-seal in both bowl and trap. The siphon is broken by admission of air through the air-pipe C.

This breaking of the siphon is an ingenious and most simple device, which will be explained by referring to the sectional view of the cistern.

The air-pipe C leads to the point F; it is surrounded by the injector-pipe f, and both are covered by a capped or inverted tube reaching downward to the point G. These pipes are again encased by the tube H, which passes through the reservoir of the cistern to the coupling I, to which is connected a vent-pipe leading to a heated flue, or to the roof.

When filling the flushing-chamber (or service-box) the water traps the air-pipe inlet at G and shuts off all air. Siphoning of the bowl begins and continues after closing the valve A, until the service-box empties itself to the point G, when air is again admitted through the air-pipe, thus breaking the siphon. The portion of the water then left in the service-box is used to refill the bowl.

It is claimed that this natural method of operating a water-closet with a deep seal is the most perfect sanitary appliance invented. The sale of over 25,000 pneumatic closets of this make during ten years is unexcelled in this country.

The "Surf" (Fig. 118) belongs to the class of siphon

closets to be distinguished from pneumatic closets, as illustrated and described on preceding pages, and is also patented by Mr. Boyle.

In the Surf closet the bowl is flushed by the action of a siphon formed in the soil-passage, aided by a water-jet diverted from the flushing connection, and directed into

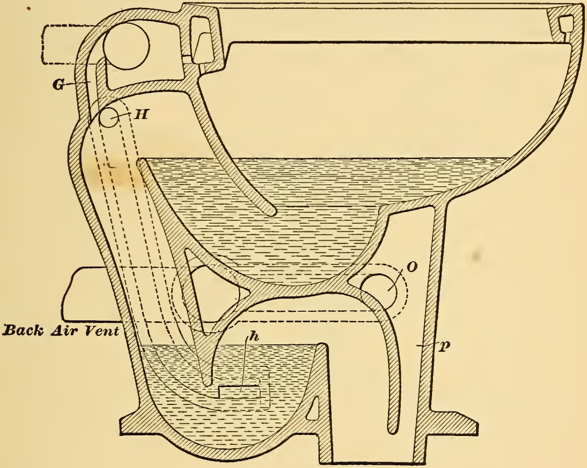


Fig. 118.

the air-space between the traps. Bowl and cistern are connected by a single 1¼-inch flushing-pipe.

EXPLANATION.

When operated, only a portion of the flushing water flows into the rim of the bowl, the remainder falls down

the jet opening G through the air-space, and compresses the air therein. This compression is instantly relieved by an escape of air through the passage H, which bubbles up from the opening h, and enters the passage on the discharge side of the lower trap. The jet effects a

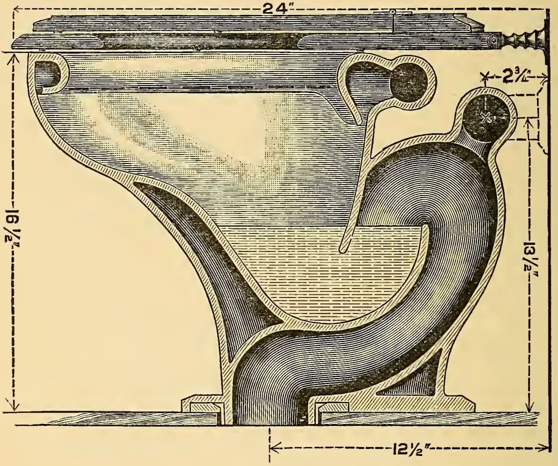


Fig. 119.

rarefaction in the upper part of the air-space, drawing the air down with it, and the bowl discharges instantaneously.

The siphon action of the closet is very strong, and continues as long as there is a full down flow of flushing water. As the flushing decreases, the siphon is broken

by admitting air into the air-space through the outlet of the bowl. The bowl is then refilled by a quick after-wash.

The bowl is ventilated through the passage p and opening o, and the external passages on both sides of the bowl leading to the back.

THE "UNION" PEDESTAL HOPPER (BOYLE'S PATENT).

The "Union" Pedestal Hopper (Fig. 119) presents many desirable features. The descending limb of the hopper is in the back, and the outlet is brought under centre of bowl, which permits setting of hopper 12½ inches from centre of outlet to wall, leaving ample space for bends and waste connections under floor. Referring to sectional view, it will be seen that this hopper is suitable for old plumbing work, as its size is kept within limits, and it may be used in place of almost any other water-closet.

The back-air vent is provided with Boyle's reversible connection; it is fully 2 inches in diameter, and placed at the crown of trap, 2¾ inches from wall.

The water-seal is 1½ inches, and as large as it can be made to insure an effective discharge of contents. The water surface is 6 by 5 inches, preventing the soiling of the bowl, an objection found in the ordinary short hopper.

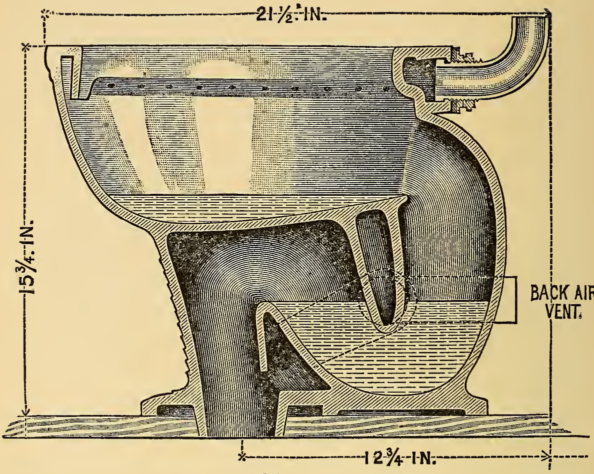


Fig. 120.

BACK OUTLET WASH-OUT CLOSET.

(Sectional view showing dimensions of closet and position of back-air vent. Distance from centre of back-air vent to floor, 5 inches.)

Fig. 121 is the same in principle as the pneumatic closet already shown in Fig. 117, but has even a stronger siphonic action, and requires the ordinary plumber's trap below the floor, as shown.

AUTOMATIC CLOSETS.

There are many places where an automatic closet must be used, such as railway stations, public buildings, institutions, etc., etc.

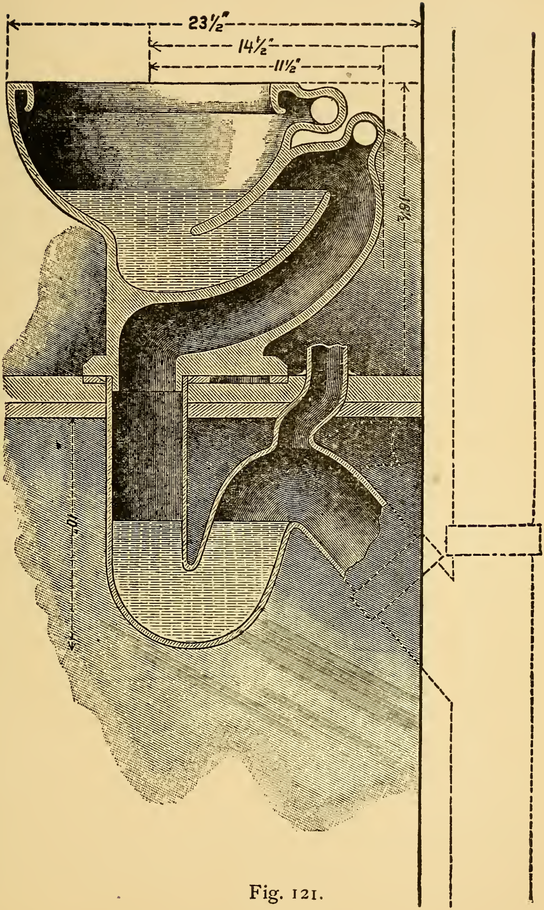


Fig. 121.

An automatic closet is one which does not require any manipulation whatever. It has no pull. The mechanism which operates it is beneath the seat, and only a very slight weight is required to work the lever which pulls the rod, to left of water-pipe, and allows the flushing process to take place.

PART XI.

SINKS.

ONE of the most difficult problems in sanitary plumbing is the disposal of kitchen waste.

The fatty substances dissolved in the hot water of dish-washing are in ordinary kitchen sinks discharged into the waste-pipes, where they quickly congeal and clog them. To overcome this difficulty innumerable devices have been invented, but hitherto without much success.

Large pot-traps have been used under the sink with the view to collecting the grease before it enters the main waste-pipes. But these traps require constant attention to remove the accumulating filth at suitable intervals, and as there is nothing in their mechanism to remind the servant when they require emptying, and as the emptying is an extremely offensive operation, owing to the putrid condition of the contents of the trap, the work is neglected, and the waste-pipes become obstructed as much as if no pot-trap existed. Moreover, the trap must, on account of its weight, be placed on or below the floor, leaving a considerable length of pipe between it and the sink outlet to be clogged.

Large grease-traps have been used, but they are open to the same serious objections as the pot-traps and utterly fail to solve the problem.

Flush-pots with ordinary outlet plugs have been tried; but as the outlets must necessarily be operated by the persons who use the sink, it is found that sooner or later they are improperly used, and then greater objections than ever result.

Any simple plug outlet in kitchen sinks offers a tempt-

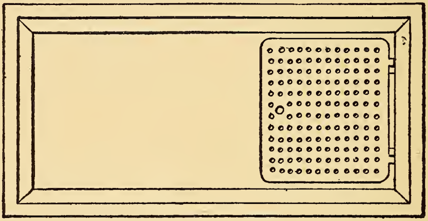


Fig. 122.– Plan of the Sanitas Kitchen Sink.

ing waste receptacle for solid refuse, which an ignorant servant is certain to scrape into it, to avoid the trouble of its proper removal; and even with the greatest care, there is nothing to prevent the accidental passage of solid matters sufficient to clog the trap, through this outlet; particularly where the strainer is movable, and in practice this is what is found to occur.

It has been assumed at the outset as an indispensable condition in the apparatus, that absolutely nothing

should be dependent upon the intelligence and care of the servant, and that by no possibility could the waste-passages become clogged, either by accident or by design. In short, that the operation should be entirely automatic, and that the form of the outlet should

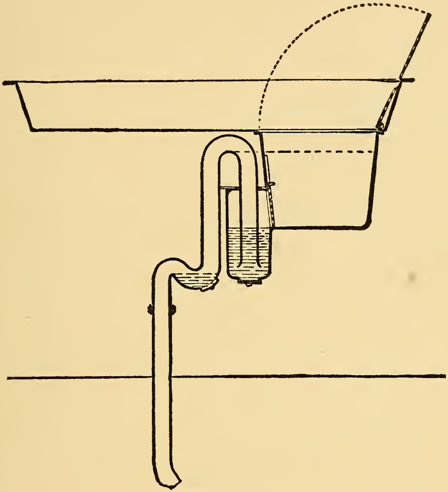


Fig. 123.

be such that no solid refuse *could possibly gain access to it.*

These results can be obtained as follows:

Fig. 122 represents the plan, and Fig. 123 the section of the apparatus. It consists of the combination of a square flush-pot with an ordinary kitchen-sink, in such a

manner as to provide a sink of the ordinary appearance and form above, but having a deep portion or flush-pot at the end, with an automatic discharge.

An upper, or horizontal strainer, covers the entire flush-pot, and is hinged to one end of the sink, so that it may be opened when it is desired to use the deep part of the sink. The sink is discharged by means of a self-acting siphon, and a vertical strainer is interposed between the flush-pot and its siphon. The short arm of the siphon is trapped with a seal-retaining trap of the Sanitas trap principle, just behind the vertical strainer. This strainer slides upward in a groove to give access to the trap when desired, but closes again automatically by its own weight as soon as released. Clean-out openings are provided at the trap and weir chamber, and give access to every part of the waste system. No bones and solid refuse can be scraped into the discharge outlet and dropped into the waste-pipe, because this pipe ascends instead of descending at the outlet; and should the trap be clogged, it will simply cause the water to cease flowing out until the obstruction is removed, which can easily be done by simply raising the lower strainer and lifting out the obstruction by hand.

Fig. 123 shows the operation of the Sanitas Kitchen Sink and Flush-pot, as follows: The sink is used in the ordinary manner until the flush-pot fills to the height of the siphon overflow. When this point has been reached, the next discharge of a quart or two of

water suddenly emptied from the washing-pan charges the siphon and causes the entire contents of the flush-pot to rush out through the waste passages, filling them full bore, and scouring them from end to end. The solid matter and large lumps of grease will be left on the bottom of the flush-pot, and must be removed by the serv-

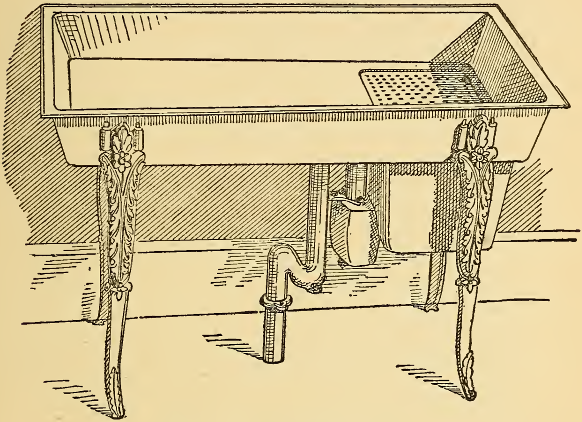


Fig. 124.—A Kitchen Sink.

ant in the proper manner, inasmuch as they cannot possibly be removed in any other way.

The foregoing description applies to a sink combining every desirable feature. The kitchen sink, such as is usually found in flats and tenements, is nothing more than a cast-iron tray, to which is connected a waste-pipe with an ᔕ-trap.

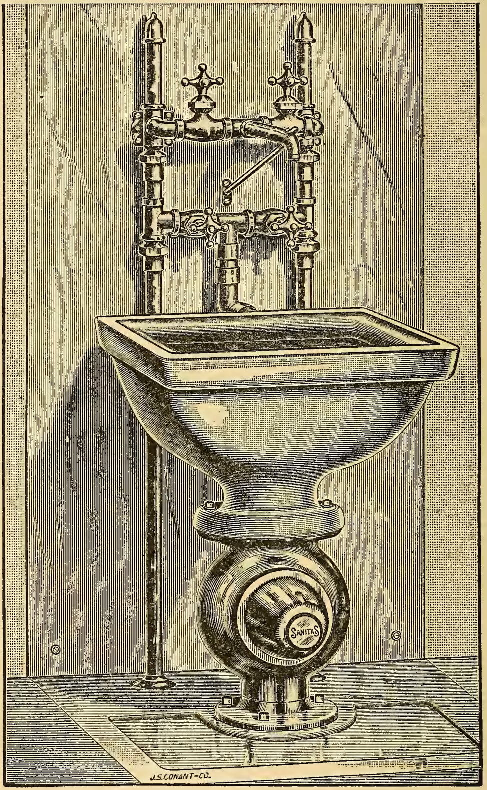


Fig. 125.—Porcelain Slop-sink, with trap and fittings made by the Sanitas Manufacturing Co.

PART XII.

CISTERNS FOR WATER-CLOSETS, ETC.

THE cistern for water-closets is the apparatus designed to always contain a sufficient quantity of water for flushing purposes. The cut (Fig. 126) will show how this is

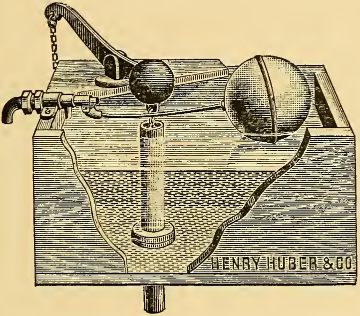


Fig. 126.

accomplished. The box is generally made of wood lined with metal. An inlet-pipe is provided with a stop-cock operated by the hollow ball. When the cistern is empty, the ball drops to the bottom and in falling opens the stop-cock, water again flows in and

raises the floating ball, until at a predetermined level, it shuts the stop-cock and the flow of water ceases.

The outlet pipe is made of large diameter in order to provide for a rapid flow of water into the water-closet hopper. It is normally closed by a valve. The opening is effected by pulling a chain, which raises the valve and the weight, allowing the water to escape. As soon as the chain is released the weight falls and the valve is again closed. The valve is continued to the water level as a tube and is hollow: this is for the purpose of using it as an overflow, so that should the ball stick fast and allow the water to run, the excess would run down through the tube and do no harm.

BEAUMONT'S PATENT "POSITIVE" FLUSHING CISTERN, FOR URINALS, HOPPERS, AND LATRINES.

The cistern (Fig. 127) is provided with a pet cock connected with the supply-pipe, which can be set at will to admit more or less water. As the water rises in the cistern, it lifts the copper float A and carries it up as the water level increases. This float is attached to the lever B, having a pawl C which when tilting and slowly moving downward strikes the end of the opposite lever D, and carries this down with it, until the pawl C frees itself from the lever D. This movement of the lever D has lifted its counter weight E, which upon the freeing of the lever drops back, and in falling it acquires a considerable momentum, so that it lifts the rod F and valve G attached

to it. The siphon H is by this time nearly all under water, and as the water begins to flow out underneath the valve G it starts the siphon, and empties the cistern.

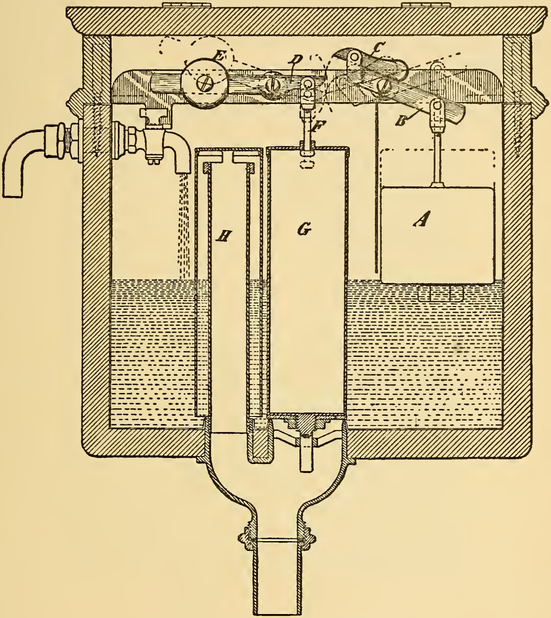


Fig. 127.—Sectional View.

The suction of the flushing water quickly draws the valve back to its place. The operation of this flushing cistern is positive under all conditions, whether there is a quick and heavy supply of water, or a slow filling of

the cistern under a very low pressure. The cistern is also well adapted for flushing hoppers and latrines, as it is made of any desired size to flush from 2 or 20 gallons of water at a time; it is therefore a most desirable appliance for public places, hospitals, and railroad depôts, where a number of fixtures are constantly in use.

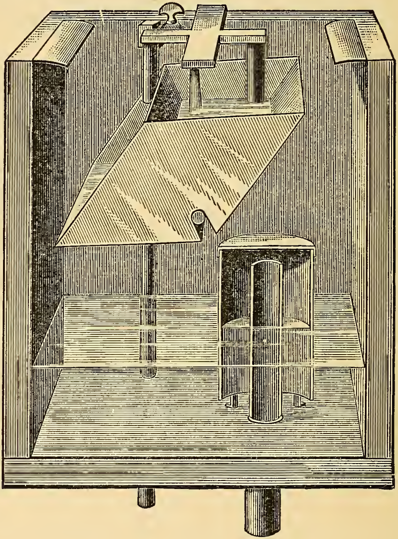


Fig. 128.

BOYLE'S PERIODICAL FLUSHING CISTERN, FOR URINALS.

The construction of this cistern is extremely simple, the operation is positive, and will be easily understood by referring to the sectional view (Fig. 128). It shows the cis-

tern half filled, the supply-cock is open and fills the right-hand compartment of the tilting bucket. The bucket tilts when full, emptying into the cistern, and this brings the left-hand compartment under the supply-cock. It tilts again when filled. This operation is repeated several times, until the water is at a height nearly level with the stand-pipe, and another turn of the bucket starts the siphon, emptying the cistern and flushing the urinal.

PART XIII.

BATH-TUBS.

BATH-TUBS are made of iron, copper, zinc, earthenware, marble, or, in short, of any substance which can be made to hold water. There is no question about which is the best. The porcelain tub is preferable to any other; after it comes the porcelain-lined tub, which is made of iron, with a coating of so-called porcelain over its inner surface.

Bath-tubs nowadays form one of the most important fixtures in a modern residence. With the exception of tenements, rookeries, and old houses, probably every modern residence and flat in New York possesses a fixed bath-tub. Indeed, there are a few mansions with a plunge-bath in the cellar.

A bath-tub, when set up properly, is connected with a hot-water pipe, cold-water pipe, overflow-pipe, and waste-pipe. See Fig. 129, which shows a porcelain-lined tub of the latest improved style with open plumbing.

In setting bath-tubs a trap must always be used between the tub and the branch or main soil-pipe. There are instances where the trap can be dispensed with; as,

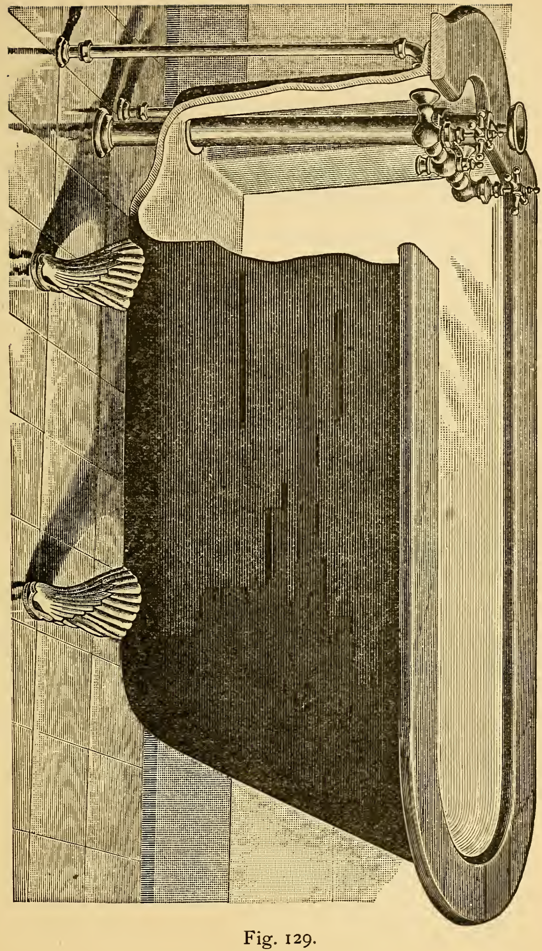


Fig. 129.

AN IDEAL BATH-TUB.

for instance, where the waste can enter another waste-pipe directly above its trap, but it is not a desirable arrangement.

SHOWER-BATH.

The shower-bath, douche, and needle-bath are all variations of the same thing. A shower-bath, with a hand-spray attached, is shown in Fig. 130. A shower-bath is also provided with both hot and cold water, admitted through the pipes you see ascending from the floor to the faucets. Hot and cold water can be drawn jointly or singly by manipulating the faucets, which admit the water from both pipes to the single pipe which supports the rose. The shower descends to a tray of marble or other material, and finds its way through a waste-pipe trapped in the usual manner.

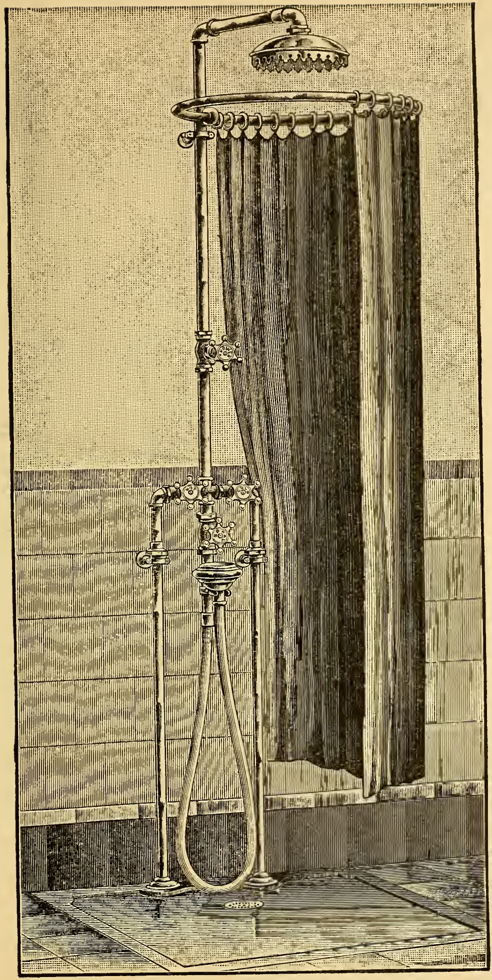


Fig. 130.

PART XIV.

WASH-TUBS.

NOT long ago, even a city wash-tub was a veritable tub of cedar hooped with iron, like a pail. Nowadays the wash-tubs found in houses of only modest preten-

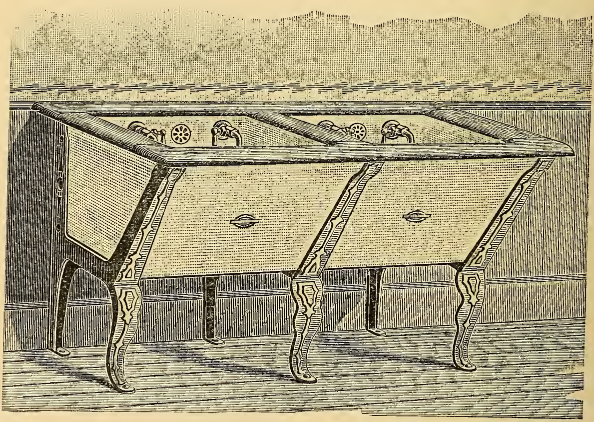


Fig. 131.

sions are handsome-looking fixtures, with hot and cold water connections (see Fig. 131).

These tubs are set two, three, or four in a row, and

sometimes more, all connected to the same waste-pipe, with one trap serving for the whole.

The drawing shows a pair of porcelain tubs made by the Henry Huber Co., of New York. Wooden tubs are not desirable, as they will smell.

Wash-tubs are the medium by means of which soap in large quantities finds its way into the waste-pipe. It is true the soap is dissolved, but some of it invariably sticks to the waste-pipe, and together with bits of thread, unravelled cotton, etc., finally chokes up the waste-pipe altogether. As usually set, the tubs do not permit of a sufficient fall being given to the waste-pipe, especially if there are three or four tubs. Therefore every wash-tub waste-pipe should have a screw, or some means provided in order that it may be easily cleaned out.

The suggestion on the following page is applicable particularly in flats, where the waste will be found very often connected in the manner shown.

It suggested itself to the author as a simple and efficacious way of providing means to clean out the wash-tub waste-pipe, A, A, which frequently becomes clogged. It is very seldom, in setting up wash-tubs, that a sufficient fall is given to the waste-pipe, A. As the wash-tubs are frequently used for other purposes, especially in tenements, where they do duty as ice-boxes and coal-bins, it is no wonder they sometimes become obstructed. The obstruction is generally to be found in the lower section, marked A; there is usually a faucet,

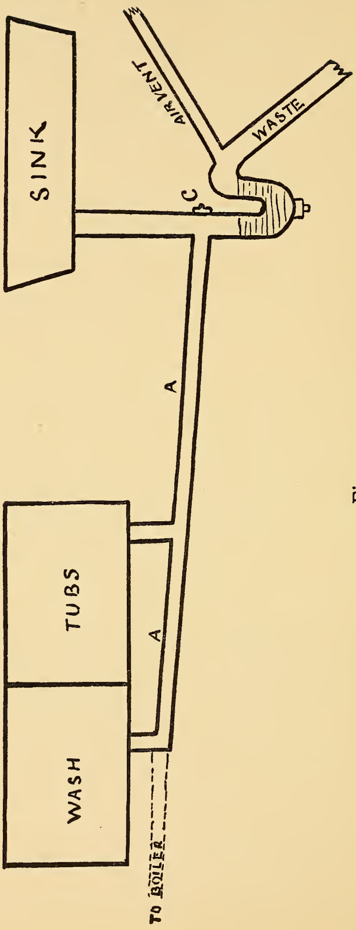


Fig. 132.

A suggestion by the author, showing the position of the screw at C for the purpose of cleaning out the waste-pipe A, A.

which, when opened, permits hot water from the boiler to flow through the pipe A. Now, there is no way, except by cutting, of removing an obstruction from the pipe A, A, as the turns in the joints are too short for a rattan. The author therefore recommends the use of a screw at C, directly opposite the end of pipe A, A, which could be removed for the insertion of a rattan into the waste-pipe. The same kind of a screw as the one used in the bottom of the trap is required.

PART XV.

KITCHEN BOILERS.

THE original kitchen boiler—and it is still in use in England — consisted of an iron water-trough, placed alongside the grate. This trough required to be filled by hand; it held but a few gallons of water, and frequently blew up, necessitating a new kitchen fireplace, new furniture, and very often a funeral. This boiler never blew up when full, the water never became hot enough for that. It blew up when empty and hot, as any other boiler which is acted upon by the fire direct will do if suddenly deluged with water.

The modern kitchen boiler is the result of a knowledge of the fact that hot water ascends, while cold water descends; that is to say, if a vessel of water be placed upon a fire, the water in the bottom of the vessel of course becomes heated first; as it acquires heat it ascends to the top, allowing the colder water to pass down and be heated in its turn, this process continuing so long as the body of water can be heated unevenly. This is called circulation, and because of it we have our modern kitchen boiler, which doesn't blow up.

A little experiment will show the truth of the foregoing statement.

Instead of putting the vessel of water on the fire, put the fire on the top of the vessel of water; the result will be a little hot water in the top of the vessel; the water in the bottom will remain perfectly cold.

To heat the water in a suitable boiler for household purposes, it is not necessary that the boiler should be acted upon by the fire; a pipe properly connected, which passes through the fire, is sufficient. Such an arrangement is shown in Fig. 133.

F.—Cold water supply-pipe.

E.—Interior tube intended to convey the cold water supply and discharge it near the bottom of the boiler.

I and H.—Cold water circulation pipes connecting the bottom of the boiler with the water-back.

K.—Water-back.

J.—Hot water circulation pipe connecting the water-back with the side of the boiler, at about one-quarter its height.

A.—Hot water delivery-pipe.

G.—Sediment-pipe.

A glance at the section will show at once what takes place within the boiler. It will be noticed that the cold water supply-pipe goes down inside the boiler to near the bottom; this is so for two reasons: first, that the cold water may not mix at once with the hot water in the top of the boiler; and, second, that the cold water may pass

through the hot water before it is discharged into the boiler. The pipe, I, H, takes the cold water from the bottom of the boiler to the water-back, K, where the water is heated, causing it to flow upward through the

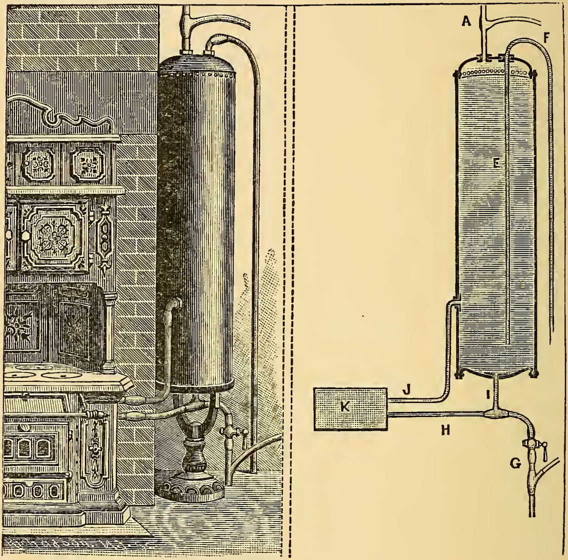


Fig. 133.

pipe, J, into the boiler, where, by virtue of the circulation process already described, it immediately finds its way to the top of the boiler, where it is stored until the rest of the water becomes equally heated. It then de-

scends again, passes through I and H, through the water-back, up J to the boiler, and so on *ad infinitum.*

It is seen at once that our modern boiler cannot blow up like our old-country friend the water-trough.

Nothing of the kind can happen to our boiler. If it should become empty, the water-back would probably crack with the very first touch of cold water, but this would not affect the boiler itself. On the other hand, should the water in the boiler become overheated no harm could result, because the supply-pipe, E, F, would take the pressure, which would merely back up the water in the main or tank, as the case may be.

But here a problem presents itself, which problem is the outcome of unforeseen circumstances. It may happen that some outside cause—such as a fire-engine drawing water from the same main ; a break in the main ; or a heavy leak in the supply-pipes,—will draw the water from the boiler and its connections. Under such circumstances, there being no way for the entrance of air, the boiler collapses. It collapses because nature abhors a vacuum.

Now, the problem is this, to prevent the water from leaving the boiler in any but the proper manner, viz., through the pipe A.

This problem is solved by means of a check-valve placed somewhere in the supply-pipe between the main and the boiler. The check-valve is automatic in its action. While it allows the water to enter freely

through the supply-pipe, it will permit no water to pass out by the way it came in.

But—and, again, but—the check-valve not only prevents the water being drawn from the boiler, *it also con-*

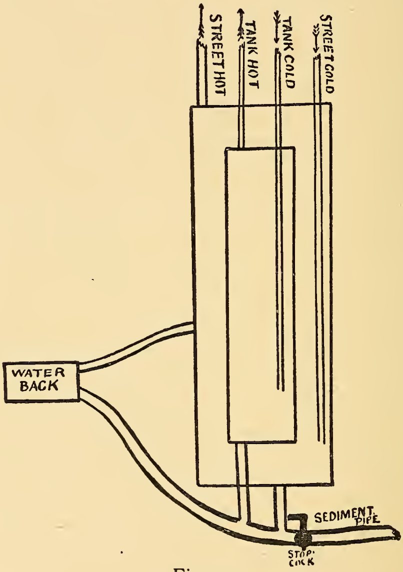


Fig. 134.

fines the pressure, if the boiler is overheated. The natural and only safety-valve for a kitchen boiler is the supply-pipe; stop that up, and the result must at least be an undue strain, though, fortunately, very seldom an explosion.

DOUBLE BOILERS.

Double boilers are used where the head of water is not sufficient to supply the upper floors of a house where but one boiler is used.

The double boiler simply consists of one boiler within the other, the outside boiler being connected with the street main, and the inside boiler with the tank. The water-back is connected with the outside boiler only, which in turn heats the water contained in the inside boiler.

A reference to the illustration (Fig. 134) shows plainly how this is accomplished. The baths, wash-basins, etc., situated on the floors above the head of the water supply from the street, are all connected with the outlet-pipe, marked " tank hot," while all the fixtures below the head of water supply are connected with the pipe marked " tank cold." The water supply is connected from street and tank as marked.

Double boilers, together with the arrangement known as Boyle's patent cut-off, can be dispensed with by using a pump, which is placed usually in the cellar, for the purpose of pumping hot water. But the excessive labor involved in pumping water to the height of even two stories is an objection, if done by hand.

BOYLE'S PATENT CUT-OFF—TO TAKE THE PLACE OF A DOUBLE BOILER.

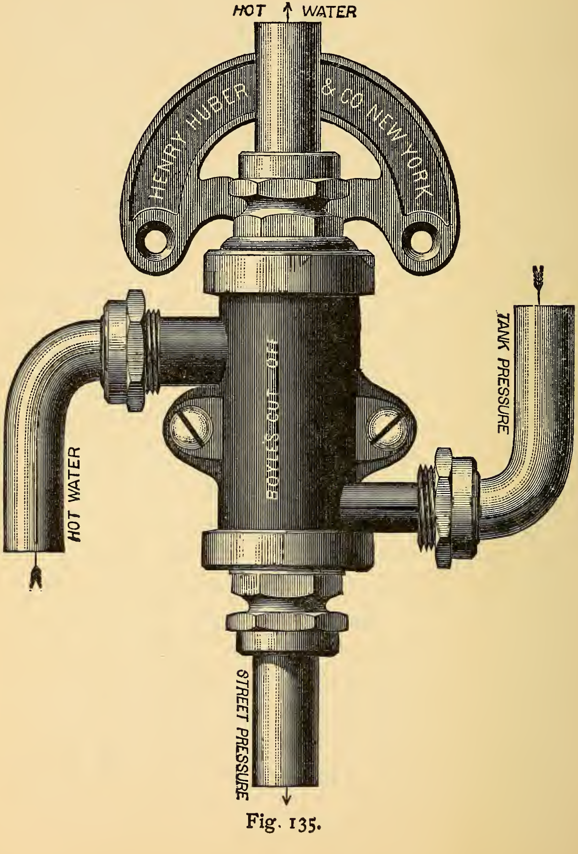


Fig. 135.

BOYLE'S PATENT CUT-OFF.

To save the complications and excessive cost of the two boilers and their connections Boyle's patent cut-off was devised (see Fig. 135).

We have already said that in dwellings where the street-pressure is not sufficient to deliver water in the upper part of the house, it is customary to supply this portion from a tank, which fills at night through a float-valve or into which the water is forced through pumps. This arrangement answers well for cold water, but in order to provide the upper stories with hot water, two distinct hot-water systems become necessary, or the employment of two boilers, one within the other; one holding hot water under high-pressure sup-

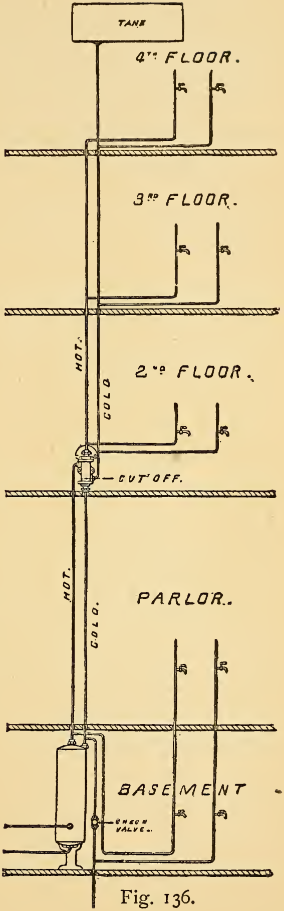
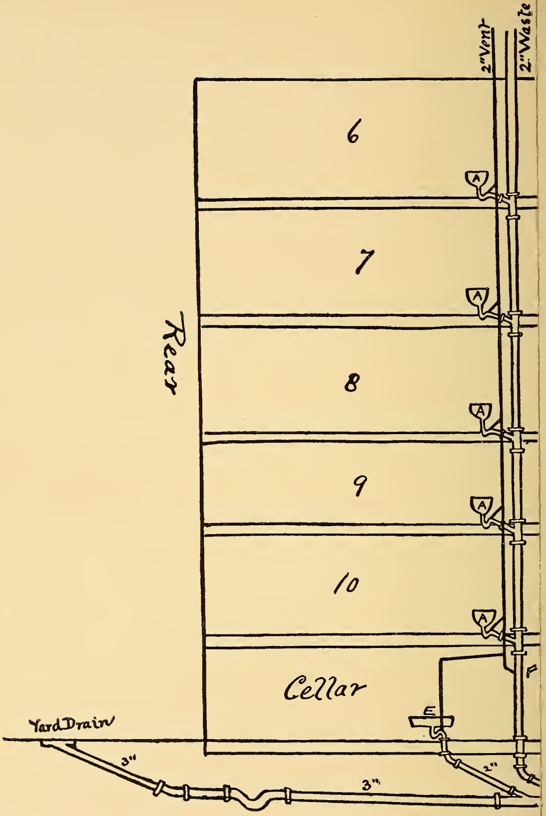


Fig. 136.

plied from the tank and connected with the faucets on the upper floors, and the other, being the low-pressure boiler, supplied from the street-main and connected with the faucets on the lower floors.

Fig. 136 shows the cut-off connected with the tank and boiler. The faucets on the lower floors, in this instance, basement and parlor floors, are supplied from street-pressure, and at no time from tank-pressure. The faucets on the second, third, and fourth floors are supplied from tank-pressure. At the moment when a hot-water faucet is opened on the upper floors the boiler is put under high-pressure, and hot water will flow from the boiler through the cut-off, and thence to the open faucet above. Closing the faucets shuts off the tank-pressure from the boiler immediately. Place the cut-off between the two pressures, or nearer the boiler when desired. If the street-pressure still supplies the second floor, place the cut-off on the third floor; if it only supplies the basement, put it on the parlor floor. Connections for cold-water branches to supply lower floors from street-pressure must be made below the check-valve, as shown, and under no circumstances between boiler and cut-off. Supply-pipe to tank must be independent of pipes shown in diagram, and the connection with pump must be made below the check-valve.



2" Vent
2" Waste
6
7
8
9
10
Cellar
Rear
A
E
F
Yard Drain
3"
3"
2"

PART XVI.

A COMPLETE DRAINAGE JOB.

We have already called attention to various appliances, etc., and will now proceed to show a complete plumbing job so far as the connections to the sewer are concerned.

The plan (Fig. 137) shows a section of everything connected with the sewer, in an apartment-house for ten families. Each family occupies the half of a complete floor, except the family in the first floor front, who also have half the cellar. Their apartments are marked 1, the rest being marked 2, 3, etc.

It will thus be seen that as there are wash-tubs and sink on the cellar floor, it becomes necessary to run the main drain below the cellar floor.

On the drawing the soil-pipes are so marked and shown in section; the vent-pipes are marked, but are merely indicated by a line. The correct size of each is given on the plan.

The fixtures marked A, A, etc., it will be noticed are connected to the 2-inch wastes. Wherever there is a water-closet it is connected to a 5-inch soil-pipe. This

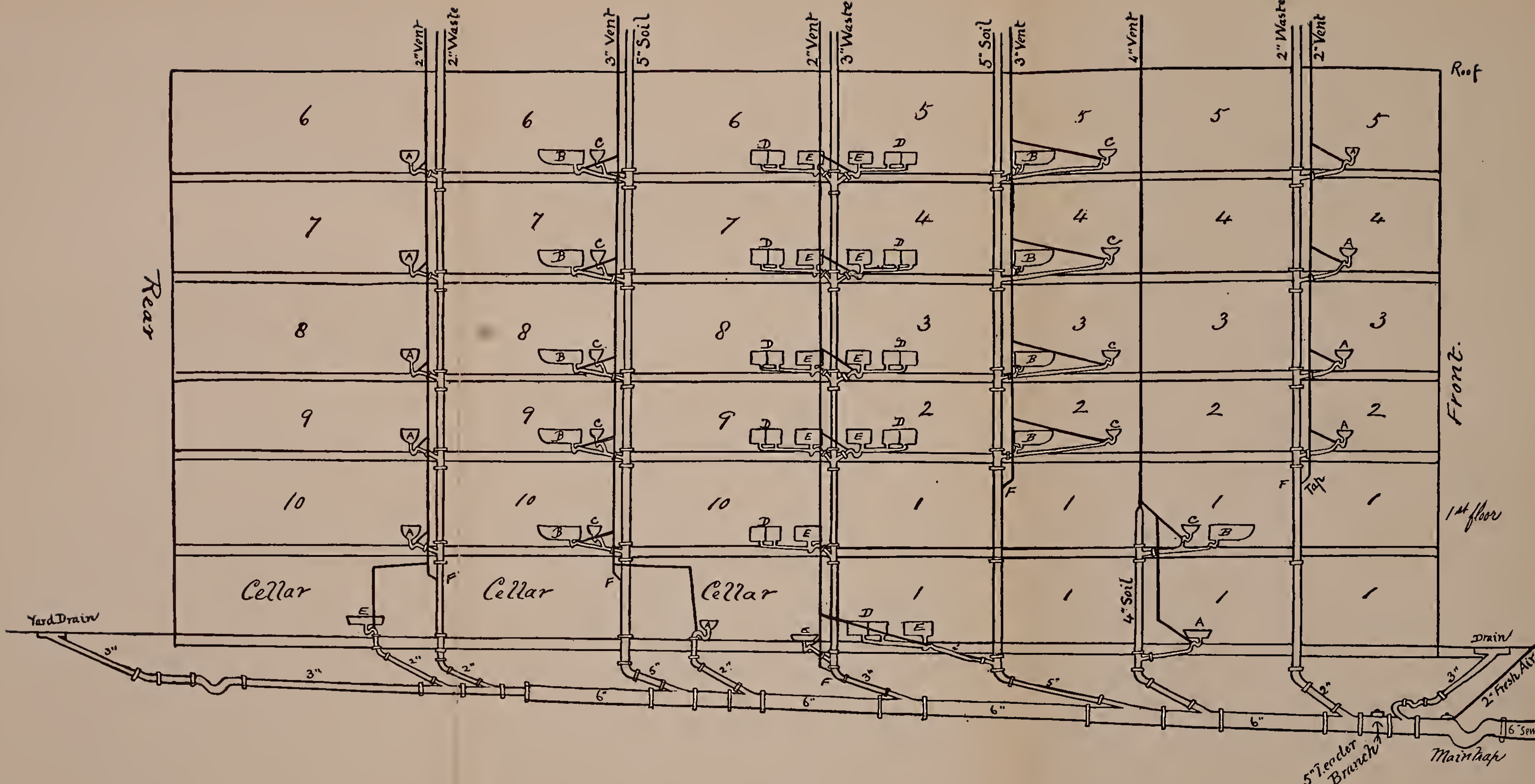


Fig. 137.

[Face p. 169.

is in accordance with the ordinances of the city of New York.

B B, etc., are the bath-tubs; C C, etc., are the water-closets; D D, etc., are the wash-tubs; E E, etc., are the sinks.

Vent-pipes are shown connected to the upper arm of every trap.

The points marked F F, etc., are the places where the soil and waste pipes are tapped for the vent-pipe. These taps are always below all the fixtures.

At the spot marked "5-inch leader branch" there is to be jointed a rain-water leader from the roof. Other leaders from the roof may enter the main drain at any place in rear of the one which is designated, provided they are trapped.

There is no excuse for any difficulty about such a job as the plan shows.

As it is generally not feasible to put in the main drain until after the soil-pipes and vent-pipes are in position, it follows that attention must be paid to the measurements, in order that the work of putting in the branches from the ends of the upright stacks may proceed without any hitch.

After your soil-pipes, waste-pipes, and main drain to the main trap are in position, the whole are filled with water, as already described on page 105, and tested for leaks.

WATER-SERVICE PIPES.

The advantages of lead pipe for water are becoming entirely overshadowed by galvanized-iron pipe, for conveying both hot and cold water to the various fixtures of a residence.

The better class of houses in New York are fitted now with galvanized-iron pipe, screwed together in precisely the same manner as gas pipe. The reason the pipe is galvanized is to prevent rust. In this, however, it does not entirely succeed, as an examination of water which has stood in such pipes, for even a short space of time, will show.

The galvanized piping is certainly more sightly, and requires a much smaller number of tacks. For overhead work it is especially desirable, as it requires so little fastening. To ensure a good job with iron pipe, requires that the work be intelligently laid out and the measurements made correctly; no guesswork will do, as this kind of pipe is not to be twisted and bent around corners, as can be done with lead pipe.

As it was necessary to find out the sewer level for your drain, so it now becomes necessary to find out the height to which the supply of water will *always* rise. This knowledge is obtained from an official known as the "tapper," whose duty it is to tap the main, and who possesses the desired information.

Now, suppose you have a house of 5 stories, 60 feet

in height, and the tapper tells you the water will rise but 20 feet. You see at once that two stories only will get water from the street. It therefore becomes necessary to place a tank on the roof (it is often put on the top floor in private houses) and provide a pump, located in the basement preferably, for the purpose of filling the tank.

To prevent the water in the tank from running back into the main, which it would do if some means were not employed to prevent it, a stop-cock is used. The stop-cock is placed at a point in the riser or main-service pipe between the pressures. That is to say, it must be just at the point to which the water from the street-main can be always depended upon to rise.

By referring to Fig. 137 it will be seen that the basement and parlor floor are supplied from the street, the floors above being supplied from the tank.

The drawing shows the piping complete for a house; a very little study will show that the same general arrangement must be followed in every case. It shows also that there does not exist the slightest excuse for the complication so often found in plumbing.

Start your job with a thoroughly understood plan in your hand, and you will be surprised to find how little real difficulty exists.

It sometimes, though rarely, happens that where a double boiler, or a Boyle cut-off is used, hot water will be found issuing from both hot and cold water faucets.

With a double boiler, it may be a defect in the inside boiler in addition to the cause itself, which is, that the street-pressure has overcome the tank-pressure. Either arrangement requires the tank-pressure to be constant. In the case where a Boyle cut-off is used, it can be corrected by inserting an inverted check-valve.

PART XVII.

PLUMBING REGULATIONS.

CIVIC communities have for many years recognized the necessity of plumbing regulations which demand a legal inspection of all plumbing work. The rules which are given in the following pages are the result of many years' practical experience, and are framed for the purpose of protecting the inhabitants of the city from defective plumbing, which it has been found is always conducive to sickness. The sanitary laws of the city of New York are framed with such care as to make them a criterion for any community. They are therefore inserted in full.

It is a matter of congratulation that such laws and regulations as those which follow, are in existence, though it seems strange that they are of comparatively recent date. As nothing in the details of plumbing is of very serious complication or difficulty, as the whole modern system is merely the outcome of a knowledge of the deadly effect of sewer gas, a knowledge certainly not new, it would appear but reasonable to think plumbing should have reached its present state of perfection at least a century ago.

HEALTH DEPARTMENT,

CITY OF NEW YORK.

THE REGISTRATION OF PLUMBERS, AND THE LAW AND REGULATIONS GOVERNING THE PLUMBING AND DRAINAGE OF ALL BUILDINGS HEREAFTER ERECTED.

CHAPTER 450, LAWS OF 1881.

AN ACT to secure the Registration of Plumbers and the Supervision of Plumbing and Drainage, in the Cities of New York and Brooklyn.

Passed June 4, 1881.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. On or before the first day of March, eighteen hundred and eighty-two, every master or journeyman plumber carrying on his trade in the cities of New York and Brooklyn, shall, under such rules and regulations as the respective Boards of Health of the Health Departments of said cities shall respectively prescribe, register his name and address at the Health Department of the said city; and after the said date it shall not be lawful for any person to carry on the trade of plumbing in the said cities unless his name and address be registered as above provided.

SEC. 2. A list of the registered plumbers of the City

of New York shall be published in the *City Record* at least once in each year.

SEC. 3. The drainage and plumbing of all buildings, both public and private, hereafter erected in the City of New York, or in the City of Brooklyn, shall be executed in accordance with plans previously approved in writing by the Board of Health of the said Health Departments of said cities respectively. Suitable drawings and descriptions of the said plumbing and drainage shall in each case be submitted and placed on file in the Health Department. The said Boards of Health are also authorized to receive and place on file drawings and descriptions of the plumbing and drainage of buildings erected prior to the passage of this act in their respective cities.

SEC. 4. The Board of Estimate and Apportionment of the City of New York shall add six thousand dollars to the apportionment of the Health Department for the year eighteen hundred and eighty-one, and shall insert the same in the tax levy, to provide for carrying out the provisions of this act, so far as it relates to the City of New York.

SEC. 5. Any court of record in said cities respectively, or any judge or justice thereof, shall have power at any time after the service of notice of the violation of any of the provisions of this act, and upon the affidavit of one of the Commissioners of Health of the said cities, to restrain by injunction order the further progress of

any violation named in this act, or of any work upon or about the building or premises upon which the said violation exists; and no undertaking shall be required as a condition to the granting or issuing of such injunction, or by reason thereof.

SEC. 6. Any person violating any of the provisions of this act shall be deemed guilty of a misdemeanor.

SEC. 7. This act shall take effect immediately.

RULES AND REGULATIONS

FOR THE REGISTRATION OF PLUMBERS, AND RELATING TO PLANS AND SPECIFICATIONS FOR PLUMBING AND DRAINAGE, ADOPTED BY THE BOARD OF HEALTH OF THE CITY OF NEW YORK, IN ACCORDANCE WITH CHAPTER 450, LAWS OF 1881.

Adopted April 3, 1883.
Amended October 27, 1885.
Amended August 18, 1887.
Amended November 6, 1890.

I.—*The Registration of Plumbers.*

RULE 1. Every plumber engaged in business in the City of New York shall appear in person at the Health Department, No. 301 Mott Street, and register his name and address, pursuant to the provisions of Chapter 450, Laws of 1881, upon the forms prescribed by the Health Department.

RULE 2. It shall be the duty of every plumber to give immediate notice of any change in residence or place of business, for the correction of the Register.

RULE 3. The list of registered plumbers shall be published in January of each year.

II.—*Of Plumbing.*

The law requires that the plumbing and drainage of all buildings, public and private, shall be executed in accordance with plans and specifications previously approved in writing by the Board of Health; and that suitable drawings and descriptions of the said plumbing and drainage shall, in each case, be submitted and placed on file in the Health Department.

No modification of approved plans, or of the work described therein, will be permitted unless the same has been previously allowed by the Board of Health on the written application of owner or architect.

Plans are approved upon the condition that such approval expires by its own limitation six months from date of permit unless work under it is then in progress. If it is not begun under approved plans within that time, such plans must again be presented to the Board for reconsideration.

Drawings and descriptions of the plumbing and drainage of buildings, erected prior to the passage of the Act of 1881, may be placed on file in the Health Department.

Blank specifications for plumbing and drainage will be furnished to architects and others, on application at this office.

As the law requires that the plumbing and drainage be executed according to a plan approved by the Board of Health, no part of the work shall be covered or concealed in any way until after it has been examined by an Inspector of the Board of Health; and notice must be sent to the Board when the work is sufficiently advanced for such inspection.

III.—*General Plan of Drainage and Plumbing approved by the Board of Health.*

The following plan of construction has been approved by the Board of Health. When the work is completed, and before it is covered from view, the Board must be notified, that it may send an Inspector.

1. In no case will the general water-closet accommodation of a tenement or lodging-house be allowed in the cellar or basement.

2. All interior water-closet compartments in tenement-houses shall be ventilated into air shafts of not less than three square feet in area. In other buildings, water-closets should not be placed in an unventilated compartment. In each case water-closet compartments should open to the outer air, or be ventilated by means of a shaft or air duct.

3. All materials must be of good quality and free from defects; the work must be executed in a thorough and workmanlike manner.

4. Subsoil drains must be provided when necessary.

When used they must be effectively trapped and means provided to maintain a seal.

5. All iron pipes must be sound, free from holes or cracks, and of the grade known in commerce as extra heavy. The following weights per lineal foot will be accepted as standards:

2 inches	....	5½	lbs. per lineal foot.	
3	"	.... 9½	"	"
4	"	 13	"	"
5	"	 17	"	"
6	"	 20	"	"
7	"	 27	"	"
8	"	.... 33½	"	"
10	"	 45	"	"
12	"	 54	"	"

6. All fittings used in connection with iron pipe shall correspond with it in weight and quality. No tar-coated cast-iron pipe shall be used.

7. The arrangement of all drainage and vent pipes must be as direct as possible.

8. Where there is a sewer in the street, every house or building must be separately and independently connected with it. When possible such connection must be made directly in front of the house.

9. Where the ground is made or filled in, the house sewer, by which is meant the portion of the drain extending from the public sewer to the front wall, must be of extra heavy iron pipe of such diameter as the Board of Health may approve. Such pipes must be laid with the joints properly calked with lead.

10. Where the soil consists of a natural bed of loam, sand, or rock, the house sewer may be of hard, salt-glazed and cylindrical earthenware pipe, laid on a smooth bottom, free from all projections of rock and with the soil well rammed to prevent any settling of the pipe. Each section must be wetted before applying the cement, and the space between each hub and the small end of the next section must be completely and uniformly filled with the best hydraulic cement. Care must be taken to prevent any cement being forced into the drain to become an obstruction. No tempered-up cement shall be used. A straight edge must be used, and the different sections must be laid in perfect line on the bottom and sides.

11. The house sewer must, where possible, be given an even descent to the street sewer, of not less than one-quarter of an inch to the foot.

12. Where there is no sewer in the street, and it is necessary to construct a private sewer to connect with a sewer in an adjacent street or avenue, it must be laid outside of the curb, under the roadway of the street on which the houses front, and not through the yards or under the houses.

13. The house-drain must be of extra heavy iron pipe, with a fall of at least one-quarter inch to the foot.

14. Where water-closets discharge into it, the house-drain must be at least four inches in diameter.

15. It must be securely held in place against the cel-

lar wall or properly suspended from the cellar ceiling. It can be laid under the cellar floor only when a permit from the Board of Health has been obtained.

16. It must be laid in a straight line, if possible. All changes in direction must be made with curved pipes, and all connections with Y-branch pipes, and one-sixteenth or one-eighth bends.

17. Any house-drain or house-sewer put in and covered without due notice to the Health Department, must be uncovered for inspection at the direction of the Inspector. Old sewers or house-drains can be used for new houses only when found by an Inspector of this Department to conform in all respects to the regulations governing new sewers and drains.

18. A running or half-S trap must be placed on the house-drain at an accessible point near the front of the house. This trap must be furnished with a hand-hole for convenience in cleaning.

19. Hand-holes for cleaning on the house-drain or its branches, or their traps or on the house-drain trap, must be provided with proper ferrules with screw covers made gas tight.

20. There must be an inlet pipe for fresh air to enter the drain just inside the trap, of at least four inches in diameter (or of the same diameter as the house-drain if that is less than four inches), leading to the outer air and opening at some place and in the manner shown on the approved plans, not less than fifteen feet from the near-

est window. No cold-air box for a furnace shall be so placed that it can possibly draw air from this inlet pipe.

21. No brick, sheet-metal, earthenware, or chimney flue shall be used as a sewer ventilator, nor to ventilate any trap, drain, soil, or waste pipe.

22. Every vertical soil, waste, and vent pipe must be of extra heavy iron pipe. Where soil or waste pipes receive the discharge of fixtures on two or more floors, they must extend at least two feet above the highest part of the roof coping or light shaft louvres. All soil, waste, and vent pipes extended above the roof, must be of full calibre unless the diameter is less than four inches, in which case they must be enlarged to four inches, from a point just below the roof.

No caps or cowls shall be affixed to the top of such pipes, but in tenement-houses a strong wire basket shall be provided and securely fastened thereto in every case to cover them.

23. Soil, waste, and vent pipes in an extension must be extended above the roof of the main building, when otherwise they would open within thirty feet of the windows of the main house or the adjoining house.

24. Branch soil and waste pipes must have a fall of not less than one-quarter of an inch per foot to the pipes into which they discharge.

Horizontal soil and waste pipes are prohibited.

25. Offsets in soil, waste, or vent pipes will not be permitted where they can be avoided, nor in any case unless

suitable provision is made to prevent accumulation therein of rust or other obstructions.

26. The least diameter of soil-pipe permitted is four inches. A vertical waste-pipe into which a line of kitchen sinks discharges must be at least three inches in diameter if receiving the waste of sinks on five or more floors. All branch waste-pipes from sinks shall be at least two inches in diameter.

27. There shall be no traps on main vertical soil or waste pipes.

28. The drain, soil, waste, and vent pipes, and the traps must, if practicable, be exposed to view for ready inspection at all times, and for convenience in repairing. When necessarily placed within partitions or in recesses of walls, soil, waste, and vent pipes should, if practicable, be covered with woodwork so fastened with screws as to be readily removed.

29. All joints in cast-iron drain-pipes, soil, waste, and vent pipes must be filled with oakum and lead and so calked as to make them gas tight. The amount of lead used to a calked joint shall not be less than twelve ounces to each inch diameter of the pipe so connected.

30. The plumber will test all soil, waste, drain, and vent pipes, in the presence of a plumbing Inspector, and after due notice to the Board of Health, by a pressure test; the pressure to be applied as directed by the Inspector, and after all openings in the pipes have been securely closed by the master plumber or other person

in charge of the work. None of said pipes shall be covered until after they have stood the test to the satisfaction of the Inspector.

31. All branch lead soil, waste, and vent pipes, including bends, must be of the best quality and of not less than the following weights per lineal foot:

Diameters:	*Weight per foot:*
1½ inches.	3 pounds 8 ounces.
2 "	4 pounds.
3 "	6 "
4 "	8 "

32. Where lead pipe is used to connect fixtures with soil or waste pipes, or to connect traps with vent pipes, such branches must be as short as possible.

33. All connections of lead with iron pipes must be made with a brass sleeve or ferrule of the same size as the lead pipe, put in the hub of the branch of the iron pipe and calked with lead. The lead pipe must be attached to the ferrule by a wiped or overcast joint.

34. All connections of lead waste and vent pipes shall be made by means of wiped joints.

35. Every water-closet, urinal, sink, basin, wash tray, bath, and every tub or set of tubs and hydrant waste pipe, or other fixture, must be separately and effectively trapped; except where a sink and wash tubs immediately adjoin each other, in which case the waste pipe from the tubs may be connected with the inlet side of the sink trap. In such a case the tub waste pipe is not

required to be separately trapped. Urinal platforms, if connected to drain pipes, must also be properly trapped.

36. Special precaution must be taken to secure perfect joints between water-closet traps placed above the floor and the branch soil and vent pipes for same. Cast-iron traps must have lead calked joints.

Proper floor plates must be used with earthenware water-closet traps and the joints made permanently secure and gas tight.

37. Traps must be placed as near the fixtures as practicable, and in no case shall a trap be more than two feet from the fixture, unless permitted on the approved plan.

38. All waste pipes from fixtures other than water-closets must be provided at the outlet of such fixtures with strong metallic strainers to exclude from such waste pipes all substances likely to obstruct them.

39. In no case shall the waste from a bath tub or other fixture be connected with a water-closet trap.

40. Traps must be protected from siphonage, and the waste pipe leading from them ventilated by a special air-pipe, in no case less than two inches in diameter. Except in private dwellings, the vertical vent pipes for traps of water-closets in buildings more than four stories in height must be at least three inches in diameter. All branch vent pipes for water-closet traps must be not less than two inches in diameter, and for traps of other fixtures not less than one and one-half inches in diameter.

41. Vent pipes, unless permitted by the approved plans to be tapped into an adjacent soil or waste pipe above the highest fixture, must extend two feet above the highest part of the roof or coping, or light shaft louvres. They may be combined by branching together those which serve several traps. These vent pipes must always have a continuous slope, and be connected at the bottom with the nearest drain pipe, to avoid obstruction from rust or water.

42. No trap vent pipe shall be used as a waste or soil pipe.

43. Overflow pipes from fixtures must, in each case, be connected on the inlet side of the trap.

44. Every safe under a wash basin, bath, urinal, water-closet, or other fixture must be properly graded to, and drained, by a special pipe not directly connected with any soil pipe, waste pipe, drain or sewer, but discharging into an open sink, upon the cellar floor or outside the house. The outlets of such pipes should be covered by flap valves.

45. Water-closets inclosed by woodwork must be provided with proper drip trays or safes.

46. The drain pipe from refrigerators shall not be directly connected with the soil or waste pipe, or with the drain or sewer, or discharge upon the ground; it should discharge into an open and water supplied sink. These waste pipes and their branches should be so arranged as to admit of frequent flushing, and should be

as short as possible, and disconnected from the refrigerator. In tenement-houses it must be extended above the roof. Covering the discharge outlet by means of a flap valve is recommended.

47. The sediment pipe from kitchen boilers must not be connected on the outlet side of the sink trap.

48. The valves of cisterns must be so fitted and adjusted as to prevent wasting of water, especially where cisterns are supplied from a tank on the roof.

49. All water-closets within the house must be supplied with water from special tanks or cisterns, the water of which is not used for any other purpose. Interior water-closets must never be supplied directly from the Croton supply pipes. Except in tenement-houses, a group of closets may be supplied from one tank, but water-closets on different floors are not permitted to be flushed from one tank. In tenement-houses there must be a separate cistern for each water-closet. In no case shall there be less than one water-closet for every fifteen occupants of a building, and not less than one for every floor or story.

50. The overflow pipes from water-closet cisterns may discharge into the water-closet bowl, an open sink, or where its discharge will attract attention and indicate that waste of water is occurring, but not into the soil or waste pipe, nor into the drain or sewer.

51. Where the pressure of Croton water is insufficient to supply water-closets or other fixtures in tenement and

lodging houses, factories or workshops, water must be supplied for such fixtures from a house tank of such size as to afford an adequate supply at all times. In all other cases where tanks are not used, and the supply of water from the Croton pressure is insufficient to properly supply water for all fixtures, adequate pumps must be provided for that purpose.

52. Tanks for drinking water are objectionable, but if indispensable, they must never be lined with lead, galvanized iron, or zinc. They should be constructed of iron, or of wood lined with tinned and planished copper, or of wood alone. Overflow pipes from house tanks should discharge upon the roof, or be trapped and discharged into an open sink, but never into any soil or waste pipe or water-closet trap, nor into the drain or sewer. Discharge pipes from such tanks must not deliver into any sewer-connected soil or waste pipe.

53. When within the house the leader must be of cast-iron, with leaded joints, or of copper with soldered joints. When outside of the house and connected with the house drain it must, if of sheet metal with slip joints, be trapped beneath the ground or just inside of the wall, the trap being arranged so as to prevent freezing. In every case where a leader opens near a window or a light shaft, it must be properly trapped at its base. The joint between a cast-iron leader and the roof must be made gas and water tight by means of a brass ferrule and lead or copper pipe properly connected.

54. Rain-water leaders must never be used as soil, waste, or vent pipes, nor shall any soil, waste, or vent pipe be used as a leader.

55. No steam exhaust, blow-off, or drip pipe shall connect with a sewer or with any house drain, leader, soil pipe, waste or vent pipe. Such pipes must discharge into a tank or condenser, from which a suitable outlet to the house sewer may be provided.

56. Cellars should not be connected to the house drain unless necessary. Dry cesspools should be used where practicable. Mason's traps for yard, cellar, and area drains are prohibited.

57. Yards and areas, and open light courts must always be properly graded, cemented, flagged, or well paved and properly drained; when the drain is connected with the house drain it must be effectively trapped. Front area drains must, where practicable, be connected with the house drain inside of the running trap.

58. Cellar and foundation walls must, where necessary, be rendered impervious to dampness, and the use of asphaltum or coal-tar pitch, in addition to hydraulic cement, is recommended for that purpose.

59. No privy-vault or cesspool for sewage will be permitted in any part of the city where water-closets can be connected with a public sewer in the street.

60. When there is no sewer in the street, and no way of reaching a sewer in an adjacent street or avenue, by any means provided for in these regulations, privy-vaults

and cesspools will be permitted; but only after it has been shown to the satisfaction of the Board of Health that there is no danger of contamination of the water supply from any well in the vicinity. When so permitted, they shall be built and maintained absolutely watertight. They shall be placed, as far as practicable, from any house, and so ventilated that no nuisance shall result therefrom.

61. Before turning on the water supply, after the completed work executed under approved plans therefor has been accepted by the Board of Health, a certificate must be obtained from the Board of Health that there is no violation of law unremoved on record against the work. A water permit from the Department of Public Works must also be obtained.

By order of the Board.

CHARLES G. WILSON, *President.*

EMMONS CLARK, *Secretary.*

[LAWS OF 1887, CHAP. 84, SEC. 6, AMENDING SEC. 653, N. Y. CONSOLIDATION ACT, AS AMENDED BY LAWS OF 1888, CHAP. 422.]

SECTION 653. Every tenement and lodging house or building shall be provided with as many good and sufficient water-closets, improved privy sinks, or other similar receptacles as the Board of Health shall require, but in no case shall there be less than one for every fifteen occupants, and not less than one for every floor or story

of such tenement or lodging house. The water-closets, sinks, and receptacles shall have proper doors, soil pipes, and traps, all of which shall be properly ventilated to prevent the escape of deleterious gas and odors, soil-pans, cisterns, pumps, and other suitable works and fixtures, necessary to insure the efficient operation, cleansing and flushing thereof. Every tenement and lodging house situated upon a lot on a street or avenue in which there is a sewer, shall have a separate and proper connection with the sewer; and the water-closets, sink, and other receptacles, shall be properly connected with the sewer by proper pipes made thoroughly air-tight. Such sewer connections and all the drainage and plumbing work, water-closets, sinks, and other receptacles, in and for every tenement and lodging house, shall be of the form, construction, arrangement, location, materials, workmanship, and description to be approved, or such as may be required by the Board of Health of the Health Department of the City of New York. Every owner, lessee, and occupant shall take adequate measures to prevent improper substances from entering such water-closets, or sinks, or their connections, and to secure the prompt removal of any improper substances that may enter them, so that no accumulation shall take place, and so as to prevent any exhalations therefrom, offensive, dangerous, and prejudicial to life or health, and so as to prevent the same from being or becoming obstructed. Every person who shall place filth, urine, or

fœcal matter in any place in a tenement-house other than that provided for the same, and every person who shall keep filth, urine, or fœcal matter in his apartment, or upon his premises, such length of time as to create a nuisance, shall be guilty of a misdemeanor. No privy-vault or cesspool shall be allowed in or under or connected with any such house except when it is unavoidable, and a permit therefor shall have been granted by the Board of Health, and in such case it shall be constructed in such situation and in such manner as the Board of Health may direct. It shall in all cases be water-tight and arched or securely covered over, and no offensive smell or gases shall be allowed to escape therefrom, or from any closet, sink, or privy. In all cases where a sewer exists in the street or avenue upon which the house or building stands, the yard or area shall be connected with the sewer, that all water from the roof or otherwise, and all liquid filth shall pass freely into the sewer. Where there is no sewer in the street or avenue, or adjacent thereto, to which connection can be made, the yard and area shall be so graded that all water from the roof or otherwise, and all filth shall flow freely therefrom into the street gutter, by a passage beneath the sidewalk, which passage shall be covered by a permanent cover, but so arranged as to permit access to remove obstructions or impurities. It shall be the duty of the Board of Health to enforce the provisions of this section in regard to privy-vaults as soon as practicable, but said

Board shall permit no privy-vault to remain connected with a tenement-house later than January 1, 1887, except in the cases especially named in this section.

SPECIFICATIONS FOR THE PLUMBING AND DRAINAGE OF THE BUILDINGS HEREIN DESCRIBED.

Location Number of buildings Description of buildings Dimensions of each building
Dimensions of lots Owner address
Architect address Plumber address
How many buildings will the new ones replace?
What kind of buildings were they? How many families did each of the old buildings accommodate?
Were buildings on front or rear of lot?

Pursuant to the requirements of law, the accompanying plan for the plumbing and drainage of each of the above-mentioned buildings, and the following description thereof, is hereby submitted for the approval of the Superintendent of Buildings, the undersigned hereby agreeing to cause the work to be done and the material to be furnished in accordance therewith, with such modifications as may be required by the Superintendent of Buildings. No modification of the plans, or of the work described herein, will be made, unless the same is previously allowed by the Superintendent of Buildings, on the written application of owner or architect; and all work pertaining to the proper plumbing and drainage

of the buildings and premises which is not covered by the plans, but is found necessary during the progress of the work in order to carry into effect the true intent thereof, will be executed in accordance with the directions of the Superintendent of Buildings.

General Directions.

It is expressly understood that these specifications and the drawings submitted herewith to the Department of Buildings for approval constitute together, as approved by said Superintendent of Buildings, the plans for the plumbing and drainage of the buildings herein described; and in respect to all work not covered thereby, the plumber is to be governed by the Rules and Regulations as to plumbing and drainage established by the Superintendent of Buildings.

The plumber will furnish all materials and perform all labor requisite and necessary for putting up and completing all the plumbing work in a good and thoroughly workmanlike manner, according to the plans therefor as approved by the Superintendent of Buildings.

All materials will be of good quality and free from defects.

The diameters of pipes herein specified are inside diameters.

The   will properly close all openings in floors and ceilings about lines of drain and vent pipe, so as to

prevent the passage of foul odors from one floor to another along said lines of pipe.

The plumber will send notice to the Superintendent of Buildings when the work will begin, and also at various times during the progress of said work before any part of it is permanently covered.

The plumber will properly protect all pipes and fixtures as soon as set and close all pipe openings so as to prevent obstruction and damage.

The   will do all the excavating and refilling required for the proper carrying out of these specifications, except as such work is herein otherwise specifically provided for.

The plumber will obtain and pay for all necessary permits, and comply with all Corporation laws relating to the subject matter of these specifications.

After the completion of the work under the plans and specifications, and before its final acceptance, the plumber must obtain the certificate of the Superintendent of Buildings that there is no violation of law on record against said work, and also a water permit from the Department of Public Works. He will then turn on the water and leave everything in perfect working order.

I.—Materials, Etc.

Earthenware Pipe.

All earthenware pipe, herein specified, must be hard, smooth, salt glazed, and cylindrical, and not less than

¾ of an inch in thickness. Each length will be perfectly straight and free from any fire cracks, flaws, blisters, or other defects.

All special fittings to be of the same quality as the pipe.

Cast-iron Pipe.

All cast-iron pipe and fittings must be sound, cylindrical, and smooth, free from cracks, sand holes, and other defects, of a uniform thickness, and of the grade known in commerce as extra heavy. All iron pipe will be firmly secured in position by proper pipe supports placed not more than 5 feet apart. No tar-coated pipe will be used, but after the pipes have been tested and accepted by the Inspector they will be coated with

The following average weights per lineal foot will be accepted:

2	inches	5½	lbs. per	lineal foot.
3	"	9½	"	"
4	"	13	"	"
5	"	17	"	"
6	"	20	"	"
7	"	27	"	"
8	"	33½	"	"
10	"	45	"	"
12	"	54	"	"

All joints in cast-iron pipe will be made with picked oakum and molten lead, and the plumber will make the joints impermeable to gases, by bedding the lead with hammer and calking-iron. For each joint in cast-iron

pipe 12 ounces of lead must be used to each inch of diameter of the pipe in which the joint is made. No putty or cement joints will be permitted. The lead used for calking will be pure, soft pig lead; no old joints or other defective material will be used.

Wrought-iron Pipe.

Lead Pipe.

All branch lead soil, waste, and vent pipes, including bends, must be of the best quality and of not less than the following weights per lineal foot:

Diameter	1½	inches	....	Weight	per foot	3 lbs.	8 ozs.
"	2	"	....	"	"	4 "	
"	3	"	....	"	"	6 "	
"	4	"	....	"	"	8 "	

All connections of lead with iron pipes will be made by heavy brass ferrules of the same size as the lead pipe, set in the hub of the branch of the iron pipe and calked in with lead; the lead pipe to be attached to the ferrule by a proper solder wiped joint when practicable. No putty or cement joints will be permitted.

All connections of branch lead soil, waste, and vent pipes will be made by wiped joints.

All lead pipes will be firmly secured in place with hard metal tacks and screws, placed not more than 3 feet apart; and all horizontal lead pipes will be well

supported for their whole length by shelves or carrying strips, to be provided and put up by

II.—Tests.

The plumber will test all of the soil, waste, drain, and vent pipes herein described, including branches, in the presence of an Inspector of the Department of Buildings, and after due notice to the Superintendent of Buildings, by a pressure test; the pressure to be applied as directed by the Inspector, and after all openings in the pipes have been securely closed by the master plumber or other person in charge of the work. None of said pipes shall be covered until after they have stood the test to the satisfaction of the Inspector.

III.—Cesspools and Sewers.

No cesspools will be allowed where there is a well on the same or adjacent premises, without a special permit from the Superintendent of Buildings.

The will construct in at feet from the building, a cesspool x and deep, with inch walls, and bottom made absolutely water-tight by means of The cesspool will be covered with and ventilated by

As soon as it is possible to connect above-mentioned house with a public sewer, the owner will have the cesspool emptied, cleaned, disinfected, and filled with fresh earth, and have such connection made in the manner

prescribed by the regulations of the Superintendent of Buildings.

Private Sewers.

Where there is no public sewer in the street, and it is necessary to construct a private sewer to connect with a public sewer in an adjacent street or avenue, it must be laid outside the curb under the roadway of the street on which the houses front, and not through the yards or under the houses. Such sewer will be constructed in the following manner:

House Sewers—Excavation.

The   will make the necessary excavation for the house sewer from the   wall to the   sewer in   , making a smooth bottom for each pipe, free from all projections of rock, and with the soil well rammed to prevent settling of the pipe.

House Sewer—Earthenware.

[NOTE.—The laying of earthenware drain-pipe for house sewers, in made or filled-in ground, is prohibited by the Rules established by the Superintendent of Buildings. But where the soil consists of a natural bed of loam, sand, or rock, it is permitted to be laid from outside the cellar, vault, or area wall to the street sewer, if laid in strict compliance with the following directions.]

The   will make a separate connection for each building with the   sewer by an earthenware pipe   inches in diameter, hard and salt glazed, and not less than ¾ of an inch thick, run at a uniform grade of

not less than ¼ inch per foot, extending the same to a point not less than 2 feet outside of the outer face of the front cellar, vault, or area wall, as the case may be. Every section will be bedded in cement at the hub. The ends of the pipe will be wetted before applying the cement, and the space between each hub and the small end of the next section will be completely and uniformly filled with the best quality of hydraulic cement, care being taken to prevent any cement being forced into the drain to become an obstruction. No tempered-up cement will be used. A straight edge will be used, and the different pipe sections laid in perfect line on the bottom and sides.

House Sewer—of Iron.

Or the plumber will make a separate connection for each building with sewer in by inch extra heavy cast-iron pipe, run at a uniform grade of not less than ¼ inch per foot, to a point just inside of the cellar or vault wall, as the case may be.

The house sewer in each case will be connected to the street sewer at a point directly in front of the house for which it is laid.

Old sewers or house drains can be used for new buildings only when found by an Inspector of the Department of Buildings to conform in all respects to the regulations governing new sewers and drains. They will in each case be uncovered for examination by the .

Notice will be sent to the Superintendent of Buildings when any sewer or drain pipe herein specified is ready for inspection ; and it can be covered only after it has been examined and pronounced satisfactory by an Inspector of the Department of Buildings. In filling the trench no stones will be placed in contact with the pipe, and the earth will be thoroughly packed in without moving the pipe in the slightest degree, or starting any of the joints.

IV.—House Drain.

The plumber will make a proper connection with the house sewer by extra heavy cast-iron pipe and set a inch extra heavy cast-iron running, or half-S traps just inside of the front wall, with a hand-hole for cleaning, covered with a screw cap, properly fitted.

A fresh-air inlet of extra heavy cast-iron pipe, not less than 4 inches in diameter, will be provided and properly connected with the house drain on the inlet side of the house-trap, and extended up flush with the sidewalk near the street curb, and properly covered by a galvanized-iron grating leaded into the flagstone ; or extending to not less than 15 feet from any door or window, and opening at least 12 inches above finished grade, with cap, bend, or grating.

The will build a box or man-hole with cover about the drain-trap, so as to make it readily accessible.

The plumber will continue the house drain of extra heavy cast-iron pipe   inches in diameter, along the cellar wall or ceiling from trap to the point shown on the plan, giving it a uniform grade to the trap of not less than ¼ inch per foot. The house drain must not be laid beneath the cellar floor, unless the location of fixtures in the cellar or basement, or the drainage of yards, cellars, or areas requires it to be so laid. Make necessary changes in direction by curved pipes, and all connections by Y branch pipes and ⅛ or $\frac{1}{16}$ bends. From the points shown on the plan, branch pipes of extra heavy cast-iron to be connected with the drain pipe to receive the soil and waste pipes, the rain-water leader and the connections from the area, cellar, and yard drains.

All of said branch pipes to be of the diameter hereinafter described and as shown on accompanying plan of cellar drainage.

Where hand-holes for cleaning are provided on the house drain or its branches or their traps, or on the house drain trap, proper ferrules with screw covers will be used and made gas-tight.

V.—Surface Drainage, Etc.

All yards, cellars, areas, and light courts will be properly guarded by the owner and drained as hereinafter specified. The traps for all such drains will be placed inside the cellar wall and made accessible.

Cellars will not be connected with the house drain unless absolutely necessary; dry cesspools being used where practicable. If connected to the house drain, running traps with cut-off valves and proper water supply will be provided for each connection as follows:

The will build in each yard, cellar, area, and light court where shown on plans a brick cesspool or catch basin x x made water-tight if sewer connected; and the plumber will set over each a strainer and make connection therewith as specified.

Provide and set where shown on plans inch extra heavy cast-iron yard drain, connecting with house drain and trapped by inch running trap.

Provide and set where shown on plans inch area and light court drains connecting with the house drain and trapped by inch running trap.

If found necessary to prevent dampness, the owner will make the cellar and foundation walls impervious thereto by means of asphaltum or coal-tar pitch and cement.

Subsoil drains will be provided where necessary. Their construction, trapping, and special provision for maintaining their trap seal will be as follows:

VI.—Upright Soil, Waste, Vent, and Drain Pipes.

Soil-Pipes.

For each water-closet or line of water-closets and adjacent fixtures, as shown on plans, provide and set

inch extra heavy cast-iron soil-pipe, connecting with the house drain by a Y branch and 1/8 or 1/16 bend and extending in full calibre 2 feet or more above the highest part of the roof or coping. If near a light-shaft or other ventilating opening extend the soil-pipe feet above it. The soil-pipe to have inch Y branches for water-closets, and Y branches for other fixtures where shown on plans.

Connect with above described Y branches inch iron pipe for iron water-closet traps, short lengths of 4-inch lead pipe for earthenware water-closet traps, and short lengths of inch lead pipe for other fixtures.

Waste-Pipes.

Provide and set, with proper connections for each basin, bath, sink, urinal, wash-tub, or tier of same, where shown on plans, inch extra heavy cast-iron waste-pipe, connecting with the house drain, and terminating above the roof in the same manner as soil-pipe; said waste-pipe to be not less than 4 inches in diameted from below the roof upward. The waste-pipe to have inch Y branches on each floor; and each of the set fixtures, where shown on plans, to be connected therewith by short lengths of inch lead pipe.

All branch soil and waste pipes must have fall of not less than 1/4 inch per foot to the pipes into which they discharge.

Vent-Pipes for Water-closet Traps.

Set for all water-closets and as shown on plans, inch extra heavy cast-iron vent-pipe, connecting by short lengths of lead pipe not less than inches in diameter, with the crown of each water-closet trap, and inches in diameter for traps. Extend the main vent-pipe above the roof in the same manner as the soil-pipe, and enlarge it to 4 inches in diameter from below the roof upward, or connect with the soil-pipe above the highest fixture, as shown on approved plans.

Said vent-pipe to have inch T branches on each floor.

Vent-Pipes for Other Traps.

Set for traps of all other fixtures, as shown on plans, inch extra heavy cast-iron vent-pipe, connected by short lengths of lead pipe inches in diameter, with the crown of each trap. Extend the main vent-pipe above the roof separately, in the same manner as the soil-pipes, and enlarged to 4 inches in diameter from below the roof upward, or connect with the waste-pipe above the highest fixture, as shown on approved plans.

Said vent-pipe to have inch T branches on each floor.

There will be soil, waste and vent pipes extended above the roof of each building.

The arrangement of all pipes throughout the building

will be as direct as possible, and all unnecessary offsets must be avoided.

All vent-pipes will be graded so as to discharge water collected by condensation, and connected at the bottom with the drain, soil, or waste pipe, as shown on plans, and in such a manner as to avoid obstructions from accumulated rust. The bowing of vent-pipes must be avoided.

Whenever practicable, all pipes and traps will be left so that they may at all times be readily examined and repaired. Where they are necessarily placed in partitions or recesses in walls, they will be covered with face boards which will be fastened with screws, so as to be readily removed.

No caps, cowls, or bends will be affixed to the tops of pipes opening above the roof, but in tenement-houses the opening of each will be protected by a strong wire basket securely fastened thereto.

All pipes above an extension roof will be extended above the roof of the main building when otherwise they would open within thirty feet of the windows of the main building or of an adjoining building.

The joints between all pipes and the roof will be made water-tight by heavy sheet lead flashings or

Roof Drainage.

The will provide leader *outside* the house, of galvanized sheet iron inches in

diameter; and the plumber will connect same with the house drain by a inch extra heavy cast-iron pipe, extending feet above level and a inch extra heavy cast-iron running trap so placed beneath the ground or inside the cellar wall as to prevent freezing.

The will provide leader *inside* the house, of extra heavy cast-iron, inches in diameter, to be trapped at the base, if it opens near a ventilating shaft or window, and the plumber will make the joint between said leader and the roof by means of a brass ferrule and lead or copper tube properly connected.

When there is no sewer connection the will connect the leader above specified by inch with the street gutter or

Safes and Safe Waste-Pipes.

Underline all with sheet lead safes, of pounds per foot, with edges turned up at least inches, in a secure manner, to prevent overflow, each safe to be properly graded to the safe waste-pipe. Connect all safes with a inch pipe, discharging either into an open sink or upon the cellar floor, as the Architect may direct. The branch pipe from each safe to the main safe waste will be inch pipe.

Water-closets inclosed by wood-work will be provided with enamelled iron drip trays.

Refrigerator Waste-Pipes.

Line the spaces shown on plans and as prepared by carpenter, with pound sheet lead and connect each by a inch branch pipe with a special line of refrigerator waste-pipe. Said pipe to be inch pipe, so arranged as to discharge over a properly trapped and Croton-supplied sink, in set not more than three feet above the floor, and so placed as to be convenient for ordinary use, and with the end of the pipe covered by
In tenement-houses the refrigerator waste-pipe will be extended two feet above the roof.

Provide over each outlet of the safe waste-pipes, and of each outlet from the refrigerator waste-pipes a strong metallic strainer. In no case will a refrigerator or safe waste-pipe be connected directly with the house drain or sewer, or with any pipe which connects with the house drain or sewer.

There will be line of refrigerator waste-pipe and lines of safe waste-pipes in each building.

VII.—Traps.

Trap every water-closet, urinal, sink, basin, bath, and every wash-tub or set of tubs, and all other sewer-connected fixtures effectively in the manner shown on the plans; the traps to be as near the fixtures as practicable. The traps will be so arranged that in no instance will the

waste from a fixture pass through more than one trap before entering the house drain.

The inside diameters of traps will be as follows:

For Water-closets,	inches.
Urinals,	"
Sinks,	"
Basins,	"
Baths,	"
Wash-tubs,	"

All traps will be of the same weight and thickness as their corresponding branches. They will be well supported and set true with respect to their water levels.

Special precaution must be taken to secure perfect joints between water-closet traps placed above the floor and the branch soil and vent pipes for same. Cast-iron traps must have lead-calked joints.

Proper floor plates must be used with earthenware water-closet traps and the joints made permanently secure and gas-tight by means of bolts and red lead, or

The vent-pipe connections for earthenware traps will be made permanently gas-tight by

VIII.—Water-closet Cisterns.

The will put up, over each water-closet a cistern x x ; and the plumber will connect the same with the supply pipes by inch lead pipe, and with closet bowl by inch lead pipe arranged for the

proper flushing of the closet, and leave the whole in complete working order with the necessary chain and pull or

In no case will a water-closet within the building be flushed directly from the Croton supply pipes; and the water from cisterns which supply water-closets directly will be used for no other purpose. Where water does not rise to water-closet cisterns they will be supplied from a house tank, or pumps will be provided to properly supply the same; said pumps to be so placed, arranged, and connected as to enable tenants using the water-closets to conveniently secure at all times a proper flush for each of said water-closets.

Discharge the overflow pipe from each water-closet cistern into the bowl of the water-closet. In no case will it discharge into the soil or waste pipe or into the drain or sewer.

IX.—House-supply Tank.

Provide and set on   a tank for drinking water, to hold   gallons, lined with   , and constructed of   .

Make all necessary connections with supply and house pipes as specified under Water Supply (page 213).

Provide a   inch overflow pipe and a   inch emptying pipe, each to be discharged as follows:

Provide a   tell-tale pipe and

The discharge or emptying and overflow pipes will not be connected in any way with any soil, waste, vent, or drain pipe.

Pumps.

If the pressure of the Croton be found to be insufficient to supply any fixture or any water-closet tank, provide and set up a   pump, to supply house tank or   pumps for each   and make all necessary connections as specified in detail under Water Supply (page 213).

X.—Number, Location, and Description of Fixtures.

Supply and set up in complete working order the following fixtures of the pattern and kind hereinafter described; the exit pipes to wash-basins, bath-tubs, wash-tubs, and sinks to be provided with strong metallic strainers:

	Yard.	Cellar.	Basement.	1st Floor.	2d Floor.	3d Floor.	4th Floor.	5th Floor.	6th Floor.
Water-Closets.....									
Urinals...........									
Wash-Basins.....									
Bath-Tubs........									
Wash-Tubs.......									
Sinks............									
Pumps............									
Refrigerators......									

XI.—Water-supply Pipes.

The plumber will grade each line of supply pipe so that it can be completely emptied at its lowest point.

Water pipes in exposed places will be packed by the . with mineral wool, or other substance equally good, to prevent freezing, and will be properly boxed and cased to the satisfaction of the Superintendent of Buildings.

The will excavate for and the will insert inch tap in street main, if necessary.

The plumber will connect tap and house supply at point indicated on the plans by inch lead pipe, to weigh per foot, to be laid feet below curb level.

Also place a stop-cock at to shut off the water when necessary.

Description of quality, diameter, and weight of supply pipes to fixtures.

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